For Arguments Sake, Let's use Technology in the Science Classroom

By

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Chapter I: Introduction

Rationale

In everyday life, argumentation is what occurs when two or more people have conflicting views and discuss their differing views in the hope of winning or convincing the other party that their view is right. In science, argumentation is not about "winning" the argument; rather it is used as a way to look at relationships between ideas and evidence (Duschl & Shouse, 2007). Argumentation is an important topic in the field of science that it has been included in the F*ramework For K-12 Science Education* (NRC), under the #7 essential element for science and engineering curriculum: "In science, reasoning and argument are essential for identifying the strengths and weaknesses of a line of reasoning and for finding the best explanation for a natural phenomenon" (NRC 2012 p. 52). It is important to note that because argumentation can take many different roles, students must be taught the skills necessary to have scientific argumentation (Duschl & Shouse, 2007).

Chen & Steenhoek (2013) presents a framework for the formation of an argument. First, a question is asked to promote discussion and discourse. Next, a claim is made in an attempt to answer the question. After a claim is made, evidence is collected usually in the form of data, in an attempt to support the claim. The importance of this framework is that all claims are supported by appropriate evidence. This brings about another important aspect of argumentation: students must be able to identify and apply appropriate evidence to their argument.

One type of argumentation used in the science classroom is argumentation of Socio-Scientific Issues (SSI). The research surrounding the use of SSI in the classroom

is conflicting. Some support its use in the classroom because it is more engaging and meaningful to the students (Patronis et al., 1999. If the topics relate to their lives, they will take more interest in the topics (Lee, 2007). Also, the process of collecting evidence in support of claims provides students with an opportunity to better understand and appreciate the Nature of Science (NOS) (Wolfensberger, Canella, & Kyburz-Kaber, 2010). The NOS is defined by Crowther, Lederman, and Lederman (2005) as follows:

- That science is a way of knowing, and there are values and beliefs inherent to the development of scientific knowledge;
- That the philosophy, history, sociology, and psychology of science affect science teaching and learning;
- That science is a human endeavor and that people of all ages, races, sexes, and nationalities engage in this enterprise; and
- That science is based upon evidence—not logic or faith.

If students have a better understanding of the NOS, they will be better able to form arguments and make decisions (Bell & Lederman, 2003). One of the difficulties of using SSI is that there are certain factors that cannot be taken into account using quantitative data, such as political and social reasons. Students will often making decisions based on personal experiences instead of evidence (Lee, 2007). In addition, students often have a difficult time identifying or applying data that is significant to their argument (Sadler, Chambers, & Zeidler, 2004). Another issues associated with SSI is that there is no "right" answer to the question that the students are arguing (Ratcliffe, 1997).

In the 21st century the use of technology is becoming more prevalent in the classroom. Through the use of technology, students will use advanced search engines to

research evidence to support their claims. To allow students to better communicate and share the evidence collected with their classmates, they will be using a learning management system called "Schoology." This will not only allow students to better organize their evidence, but it will also provide them the opportunity to discuss evidence and make sure that it relevant to their claims. Finally, students will collect their own evidence by researching their own evidence they will have a greater understanding and appreciation for the field of science. This project is significant to the field of science education because students will be required to use advanced technology to make educated decisions on issues in their everyday life. The amount of information on the Internet is overwhelming, and new information is added every second. Students must be able to identify valid information, and communicate that information with others as they form decisions.

There is much research concerning the use of SSI argumentation in the science classroom, but one area that they are lacking is incorporating technology into the process. The development of this thesis project is focused on incorporating technology to strengthen and overcome some obstacles of SSI. The use of technology is becoming more prevalent in schools today, but improvements concerning the use of it are available. Through the use of technology, students are better able to form learning communities, communicate, conduct research, and as a result have more effective arguments.

Significance of Project

The use of SSI argumentation has been used in the classroom to develop students understanding of scientific issues, but the current use is limited in how far the student's understanding can go. The issues currently facing SSI argumentation in the classroom are: student's lack of knowledge of the NOS, lack of communication between students, and engagement of students in developing evidence to support claims. My project will take these weaknesses of SSI, and improve them through the use of technology.

Overview of the following chapters

Chapter I: The strategy of using SSI in the classroom is a practice that has been used in the past as a way to enhance students understanding of the NOS. However, some issues with using SSI in the classroom are students have a difficult time forming good arguments because there are many factors to take into account such as social and cultural, students often apply their own opinions without relevant evidence, and in SSI there is no objective answer in the end. The significance of this project is to use technology to as a tool to perform enhanced research to collect evidence, and create online learning communities to share resources, and collaborate with students from around the world on important issues. It is through technology that the concerns of using SSI in the classroom can be met.

Chapter II: The science classroom of the 21st century looks much different than it has in the pasted. There is much more emphasis on creating student centered classrooms. One specific strategy that has been used to promote student centered learning and a

deeper understanding of the NOS is argumentation on SSI. Through the use of SSI students create arguments and make decisions on real world issues that are relevant to them. With these real world issues, students collect evidence to explain and support different perspective on an issue. Some concerns that arise with the use of SSI in the science classroom is that students have a shallow understanding of the topic being studied; as a result they cannot form good arguments. Students have a difficult time using evidence that is both valid, and relevant to the topic. Often times, students will make decisions and form arguments based on social and cultural factors rather than quantifiable data. Finally, SSI is very time consuming and in the end there is no objective answer. Technology can be used as a way to lessen or solve these concerns in SSI. Through the use of technology, students have access to a vast amount of information, which can be used to form better arguments. Advanced search engines allow students to narrow down their search results, and filter out any untrustworthy resources. Using evidence collected this way; students can collaborate with classmates and individuals around the world using Course Management Systems (CMS), and web 2.0 resources such as wikis, blogs, and podcasts. It is through the use of SSI supported by the use of modern technology that students can gain a better understanding of the topics being studied in science class and the NOS.

Chapter III: The design of this project is to enhance student learning in the science classroom by combining technology and SSI. The lessons are aimed towards middle school science students, and the topics range from conducting research, forming arguments, environmental issues, geology, and astronomy.

Definition of Terms

Argumentation- The intentional explication of the reasoning of a solution during its development or after it.

Socio Scientific Issues (SSI)- Controversial social issues which relate to science.

Claim- Proposed idea or conclusions whose merits are to be established.

Evidence- Facts and information, usually in the form of data used to support a claim.

Learning Management System- is a software application for the administration, documentation, tracking, reporting and delivery of e-learning education courses or training programs.

Nature of Science-

- That science is a way of knowing, and there are values and beliefs inherent to the development of scientific knowledge;
- That the philosophy, history, sociology, and psychology of science affect science teaching and learning;
- That science is a human endeavor and that people of all ages, races, sexes, and nationalities engage in this enterprise; and
- That science is based upon evidence—not logic or faith.

Chapter II: Literature Review

Overview

In the past, science class was viewed as an area where the teacher was the dispenser of knowledge, and it was the student's responsibility to memorize this knowledge (Bell & Lederman, 2003). However, this type of learning is not consistent with the Nature of Science, Science is not about memorizing facts, rather it is about constructing knowledge through the use of evidence and argumentation (Sadler, 1999) Today, many researchers support the use of student-centered classrooms. It is with this type of class that a scientific learning community is formed. In this community, each student plays his or her own role as they explore the field of science. To add to the quality of the student-centered classroom, teachers must provide the students issues that are meaningful to them. Socio Scientific Issues (SSI), controversial issues that occur in society that are relate to science, can be used. These topics foster scientific argumentation, which promote a deeper understanding of the unit being studied, but also enhance the student's understanding of the Nature of Science (NOS). Other research suggests that SSI has issues such as: time constraints, lack of student's scientific knowledge, student difficulty in using appropriate evidence, or ignoring evidence all together as they rely on social, cultural, or ethical variables instead. It is the goal of this review to analyze the current literature on SSI implementation, and offer solutions to the limitations through the use of technology.

Learning Science Through Argumentation of Socio Scientific Issues in the 21st Century

The use of SSI in the classroom is a strong tool to be used in the development of student's understanding of science, but it also has its limitations. Science is based on the use of evidence and argumentation, which should also be the case for the science classroom (Sadler, 1999). The use of SSI provides students with the opportunity to form scientific communities within their classrooms, to communicate and argue with their peers on topics that are relevant and meaningful to their everyday life (Newton, 1999). The focus on using SSI is not about finding the right answer, but rather the process that students go through when solving a problem (Patronis, et al., 1999). Some critics of SSI argue the following limitations: too time consuming, students do not have enough information to make appropriate decisions, and that there is no "right" answer to the problem being argued (Lewis, 2006).

The goal of my project is not to reinvent SSI argumentation, but rather to move it into the 21st century. Students in the math classroom are no longer using ancient technology like slide rulers, and the same should be true for using SSI argumentation in the science classroom. Science is not static, it is advancing at an exponential rate, and in order for students to keep up to date on current issues and new evidence, and they need to use technology. Through the use of technology, the issues and problems that are reviewed in the literature of this paper should be fixed or reduced. It is through this use of technology and SSI argumentation that students will be able to make informed decisions as educated members of society.

Educational Significance of Using Evidence Based Argumentation

Some may argue that the goal of science education is to create educated members of society that are able to make informed decisions. In order for students to gain these skills, they must learn how to create scientific arguments that are evidence based. Evidence based argumentation on SSI provide student's the opportunity to explore topics in science more thoroughly, and make informed decisions about the issues (Lee, 2007). Lee (2007) supports this statement in his study conducted in Hong Kong, in which student's had to make decisions on the policy of banning smoking in public places. They looked at evidence concerning the effects of smoking on health, and based on the evidence, they had to argue with their classmates whether or not the policy banning smoking in public places should be passed. The results concluded that students were better able to make strong organized arguments based on evidence with the guidance of their teachers. However, some students in the study still supported public smoking despite the evidence presented about the health risks of smoking. In this case student's put more value on the social aspect of smoking, despite the evidence presented to them on the health risks of smoking. This evidence supports the idea that all decisions and arguments cannot be based on qualitative data alone, factors such as social, cultural, and ethical also play a role.

Unlike Lee (2007) who focused on the final decision, a study by Driver, Newton, & Osborne (2000) focused not on solving the problem, but the process involved in generating possible solutions. This is a key factor in understanding the usefulness of SSI argumentation in the classroom. Although the students did not have a definitive answer, they went through the process of collecting evidence, weighing the costs and benefits,

arguing with their classmates, and making decisions based on this. Just as Patronis' research suggested, even though there was not a definitive answers, students were able to generate possible solutions to SSI using evidence. Similar conclusions were made by Jime´ nez-Aleixandre (2002) when students generated possible solutions to environmental issues using communication and argumentation. The focus is on the process of forming arguments using logic and evidence, not on the actual answer.

Building Learning Community

Different communities have different goals, and different ways of solving problems. In the scientific community, argumentation is used as a way to support or refute theories on how nature works (Newton, Driver, & Osborne, 1999) In the science classroom, a community should be similar to that of the scientific community, but in this case, I will refer to it as a learning community. Research supports that SSI argumentation is an important feature in building strong learning community (Bouillion & Gomez, 2001). The ideal learning community is defined as one in which the students are engaged in the topics being taught in class (Eagle & Conant, 2002). In order for this type of community to take place, the classroom environment must include: Challenging problems in which the student plays the role of decision maker, and is held accountable for his or her decisions. Most importantly, students must have sufficient and appropriate resources to provide them with the opportunity to solve problems and make appropriate decisions based on evidence (Eagle & Conant, 2002). To engage students in a particular topic, it must be a topic that is relevant to the student's life, such as topics used in SSI.

Bouillion & Gomez (2001) suggest the importance of building scientific community within the classroom to solve real world problems, in his case, urban settings. Students find learning much more meaningful if they feel the issues being studied are relevant to their everyday life.

Newton (1999) & Sadler (2009) found similar results concerning the benefits of having student centered classrooms that focus on building strong learning communities to solve problems. By creating student-centered classrooms, the students had the opportunity to be active participants in arguments, discussion, and decision-making. Sadler (2009) then goes on to offer solutions such as creating a community in the classroom where students are able to voice their opinions without fear of being persecuted for their ideas. This may include activities such as: role-play, debate, and explorative writing in which students express their thoughts concerning SSI, and compare their ideas to the literature. These learning communities will become "knowledge producing" rather than "knowledge consuming communities" (Jime'nez-Aleixandre, 2002). Although teacher guidance is important in scaffolding student's to make good arguments, teachers should provide students the opportunity to explore evidence and form their own debates (Sadler, 2009).

A shift needs to occur from teacher-centered classrooms, where the teacher is the dispenser of knowledge, to a student-centered classroom, which fosters learning communities. I think that students performing research, collecting their own evidence and data, will help in the shift from teacher centered, to student centered. With advances in technology, specifically advanced search engines like Google Scholar, evidence is much more assessable to students. Technology will allow students to communicate not

only with their classmates, but also with people from around the world, sharing and exploring ideas through argumentation and discussion making.

The Issues of Implementing SSI Debate (Argumentation)

With a better understanding of the NOS, students will have a better understanding of the concepts studied in class, and as a result form good arguments based on evidence (Wolfensberger et al., 2010). To support this statement, Bell & Ledermen (2003) also studied how students understanding of NOS affects student's ability to make informed decisions on SSI. Although the results of this study concluded that students made similar decisions on SSI despite having different view of the NOS, Bell & Ledermen (2003) still suggest that having a strong understanding of the NOS will result in more informed decisions.

Sadler (2004) suggests that through the use of SSI, students are better able to understand the NOS. This is important because with the rapid advances in science and technology, it is essential that students are able make sense of new evidence, and make decisions based on it. Driver et al. (2000) suggests that students are not provided with enough opportunity to engage in discourse on issues in society. He recommends that classrooms can achieve a more students centered classroom through the use of SSI. Zeidler et al. (2002) studied how students formation of scientific knowledge by presenting them with evidence that went against their core beliefs about scientific principles. The results from this study support that students hold many misconceptions on the NOS, and that through the use of SSI; students will be forced to look at the

evidence and make logical sense out of it. Some of the issues that were faced during the implementation of were student's made decisions not based on the evidence alone, but also on social and cultural factors. Even though the student's in Lee (2007) research knew the health risks involved in smoking and inhaling second hand smoke, some students still voted against banning smoking in public places. With the introduction of this social and cultural influence on students argumentation and decision making, many science teachers to not feel qualified to teach such issues (Zeidler et al., 2004) Along with the possible problems discussed above, Lewis & Leach (2007) cite many other areas of possible problems: Time restraints for the material that needs to be taught in a school year, trouble identifying evidence that would be useful to support claims, and the fast rate at which science is progressing, and the information that students might need in the future is not yet here.

Technology in the Science Classroom

Much has changed in the world in the past century, and one of the major reasons for these changes is the use of technology. Mini computers that can fit in your pocket are 1000 times faster than the most expensive computers 50 years ago. This exponential growth of technology is changing how society functions, and will continue to do so in the future. If technology plays such a large role in society, then why shouldn't it also play a large role in education? Students are no longer using slide rulers to make calculations in math class, then why should the science classroom continue to use the traditional method of lecture and note taking? If the science classroom is to keep pace with the technology driven society, technology must be incorporated into the classroom.

Students must be prepared to become educated members of society and make decisions that can impact the world. In order for students to make these decisions, it is the responsibility of schools promotes these skills. To accomplish this task, technology must be incorporated into the science classroom. There has been much research done on the application of technology in the classroom, but the focus here will be on how it can be used to enhance student discourse and decision making on Socio-Scientific Issues.

Collaboration and Communication

The switch from the lecture-based classroom to a student-centered classroom where students are active participants in their education has been facilitated by Course Management Systems (CMS) (Perkins & Pfaffman 2006). CMS have become popular recently because they mimic social media that students use on an everyday basis such as facebook, twitter, etc. One of the biggest dilemmas facing teachers using technology is a lack of training and knowledge on how to actually use the technology. To create a well functioning webpage to use for a high school classroom would involve time and training, something that teachers are lacking. The CMS is an easy alternative for teachers to use instead of a website. The CMS allows student participation including: uploading assignments, discussion forums, real-time chat, glossaries, quizzes, and create shared documents such as wikis. Students learn best when they work in groups to actively discussing concepts, asking questions, and through discourse. Although this can be done without technology, research supports that the use of computers enhances group work (Roschelle et al. 2000). Not only are students interacting with their classmates, but

they also have the option of communicating with other students from around the world, and experts in the field.

A specific tool that has been used to aid students in collaboration is web 2.0 technologies, which consists of wikis, blog, and podcasts. This social software gives students a workspace to share resources, asking questions, discuss concepts, and is very easy to use (Parker & Chao 2007). Other uses include: development of research projects, collaborative annotated bibliography, map concepts, presentation, share course resources, and group authoring. Hamer (2006) suggests that students can enhance their communication and research skills by creating a wiki to collaborate with partners and share resources. Wikis are great for collaboration because it allows students a common workspace, which all group members can edit, add information and ask questions.

Conducting Research Using Online Databases

Expectations for students have changed drastically since the late 19th century, where students were required to recite lines from literature and recall scientific facts on an exam. Now students are expected to extract information from large bodies of knowledge, and apply this information to make decisions and construct knowledge (Roschelle et al. 2000). The amount of information that is readily available to students in massive, and is growing everyday. One criticism of using SSI argumentation is that students lack the knowledge of scientific concepts to make good arguments. A possible solution to this problem is the use of advanced search engines and the World Wide Web (WWW) (Hoffman et al. 2003). Current students have grown up in a world where a plethora of knowledge is available at the click of a button, but with so much information

it is difficult for student to sift through to find what they are looking for. Hoffman et al. (2003) suggests that if students are provided proper scaffolding and support by their teachers, they are able to develop high level understanding of complex scientific concept. This type of scaffolding includes clear expectations, feedback, individualized scaffolding, as well as group scaffolding.

Additional research by Yang et al. (2013) supports the idea that students need to be guided in their research to promote efficient researching. However, by using online resources, students are able to collect scientific evidence, which promotes a better understanding of how scientific knowledge is constructed (Duschl & Osborne, 2002). Research supports that students are more likely to have better comprehension of complex ideas when they are actively engaged in the material. (Hoffman et al. 2003). Using technology works in two ways, it engages students, and it provides a plethora of research and knowledge for them to draw from. Activities that are focused on searching and discussing online information related to socio scientific issues can promote a better understanding of the nature of science, and as a result better decision making skills.

One initiative that was developed to assist students in researching scientific topics was an online search engine called Artemis. Artemis acted as a mediator between students and the internet, which included an online workspace, with resources that had been pre approved, and organized according to grade appropriate. The results of the study indicated that students were able to find more relevant information, and spend less time searching through inappropriate resources on the World Wide Web, and thus were able construct meaningful scientific knowledge through online-inquiry using Artemis.

Conclusion

The research behind the use of technology in the classroom has great application in the use SSI. Students are able to collect large amounts of relevant through the use of online search engines such as Artemis. With that information, students can collaborate with students from around the world using Course Management Systems, providing them with the opportunity to discuss, ask questions, and better formulate arguments. Using these tools, students are better able to make informed decisions, and formulate evidence-based arguments.

Using SSI in the classroom is a strategy, which has much area for improvement. My project will address the areas of weakness addressed in the research above by incorporating technology. Research suggests that SSI has weaknesses such as: time constraints, student's lack of scientific knowledge, student difficulty in using appropriate evidence, or ignoring evidence all together as they rely on social, cultural, or ethical variables instead. To overcome these issues my project will focus on having students use technology to collect evidence, share and discuss research with classmates using social networks such as Google drive, and communicate with individuals from around the world using online forums. This will encourage students to use evidence because they will be collecting the evidence themselves instead of having the teacher provide them prepared evidence. The use of collaborative communication using Google Drive and online forums will allow students to communicate more efficiently on evidence, saving time, and allowing students to discuss appropriate use of evidence. The use of technology cannot alone solve the issue non-quantifiable variables such as social and cultural values, but it can provide students with more perspectives to compare to.

Science is advancing at such a fast pace that students must learn how to use technology to keep pace with the Information Age. It is with this knowledge that students will be able to become active members in society, and make informed scientific decisions.

Chapter III Curriculum Project

Overview

The aim of this project is to create science lessons that focus on incorporating technology and SSI to further student learning. The lessons include introductions into conducting research using advanced search engines such as Destiny, and the formation of arguments through Claim, Evidence, and Reading (CER). The topics covered in the lessons are based on an 8th grade physical science curriculum and include environmental studies, geography, and astronomy. The individual lessons are formatted using the 5 E model and incorporate many activities that involve using computers and ipads. The activities are student centered and focus on students using technology to collect evidence and data, collaborate with classmates using the online CMS, and creating arguments on current issues.

Project Design

This project is designed to be a series of lesson plans surrounding the use of argumentation over SSI. Chen & Steenhoek (2013) suggests using the "Negotiation cycle" as a way to promote argumentation and discussion in the classroom. The Negotiation cycle is a multiple lesson process that provides students the opportunity to use argumentation as a way to develop scientific understanding. These steps include: Identifying a research question, investigating in groups, presenting arguments, compare arguments to those online, presenting revised arguments, individual written reflections. The lesson plans will be a modified version of this strategy, using technologies such as Learning Management Systems (LMS), and mediated search engines such as Destiny.

Argumentation of SSI is by no means a new strategy, but what makes this project unique is incorporating technology to enhance research, communication, discussion, and overall efficiency. Research can be enhanced through the use of advanced search engines such as Destiny or Atriums, among many others available. The advanced search engines will assist students in narrowing down their search results to the sources that are valid, reading level, and relevant to their studies. This will save students time in their search, and prevent them from using untrustworthy resources. Communication among many individuals has never been easier through the use of Course Management Systems and Web 2.0 tools, such as Blackboard, Schooolgy, Moodle, Wikis, Blogs, and Podcasts. These resources provide the students with a virtual workspace that can be used to communicate about the topic being studied. Students can share resources, pose questions, promote discussion, and formulate ideas with their classmates and others around the world. All of these resources discussed above allow for a more efficient decision making process, where more time can be spent on formulating informed decisions and evidence based arguments.

Table of Contents

Introduction Incorporating Socio-Scientific Issues and Technology in the Classroom:

Traditionally, the science classroom has been focused on memorizing "scientific facts", and having students recite these facts back on a unit exam. However, data supports that this practice is archaic and ineffective in promoting student learning and engagement. As a premise to this collection of lesson plans in this essay, I am basing the lessons on the idea that the purpose of science class is to produce educated members of society, capable of making informed decisions. The decisions that our students will make in the future will have an impact on the future of the world. However, this idea is not original, that is why I am also suggesting that classrooms must be equipped with up to date technology. Much has changed in the world in the past Century, and to keep pace, the classroom must change too. In the 21st Century, the information age, students must be prepared to enter the global economy with the skills necessary to be successful. These skills include the ability to make informed decisions on Socio-Scientific Issues (SSI), such as climate change, based on valid evidence, and communicate with the rest of world using technologies.

The use of Socio-Scientific Issues (SSI) in the classroom has been around for some time. Research supports that it has many positive attributes, such as: increased understanding in the Nature of Science (NOS), more student centered, increased engagement, and a better overall understanding of the concepts being studied. Promotes to SSI, state that students lack the knowledge necessary to make adequate decisions on issues, and dislike the idea that there is no objective answer to the question because the questions revolve around issues that no only include scientific data, but also social and cultural preferences. I would argue that the science class should mimic the scientific

community, science is founded on individuals communicating over various claims based on evidence and reasoning. In an attempt to solve or reduce the problems that critics of SSI have made, I believe that technology is the component that will fill in the voids of SSI.

Technology has been progressing at an exponential rate, and the use of it in the classroom is a necessity. Students are no longer using slide rules in math class, so why should science students copy lecture notes the same way as they have in the past? This idea is exemplified by a quote from John Dewey, "If we teach today's students as we taught yesterday's, we rob them of tomorrow." If students are to be successful in tomorrows world, they must learn using cutting edge technology. In the lessons presented in this essay, the use of technology has been intertwined into the curriculum to promote student centered classrooms and enhance student engagement in the lesson. Specifically, the use of Learning Management Systems (LMS), which allows students to communicate, collaborate, and argue using online resources. In this particular case, Schoology will be used as the LMS, but many other options are available such as: Moodle, edmodo, wiki spaces, blackboard, google hangouts, and many more. It is through this modality that students can go from being science students, to becoming part of a scientific community within their classroom.

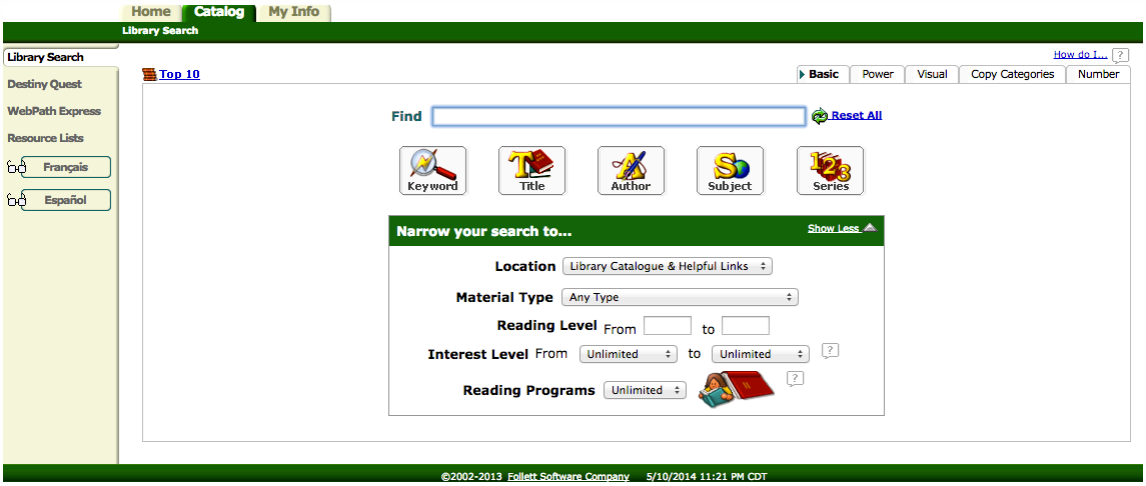
Research 101

One of the best resources available to students for researching a debate topic is the World Wide Web (WWW) because it has a tremendous amount of information available with the click of a button. However, one of the bad qualities of the World Wide Web is that it has a tremendous amount of information on it. Searching through this jungle of information can be a daunting task for an inexperienced student, trying to distinguish between accurate, reliable resources, and unreliable resource such as wikipedia and blogs.

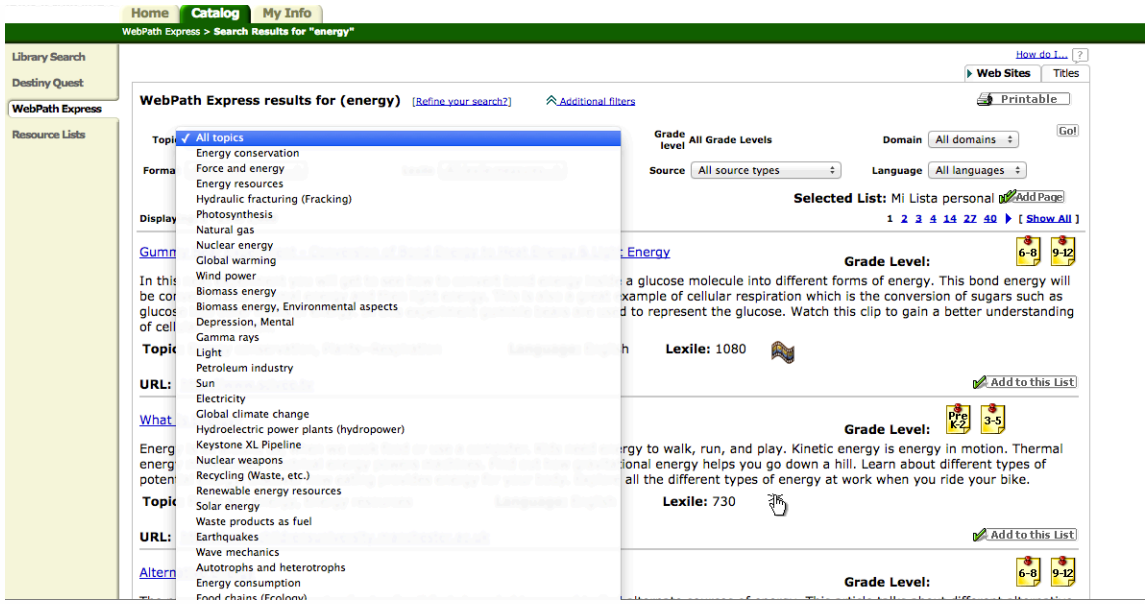
One tool that is available to assist students in this task are school-mediated databases. There are several different types of databases such as EBSCO, ERIC, SCOPUS, and Artemis. For The particular lesson set, the database "Destiny" will be used as an example for teaching students how to conduct research. However, other databases that are provided by your school or local library will work well, too.

Destiny is an online database used in grades K-12, and has all of the advantages listed above, plus more. All of the resources present on destiny have been pre approved by scholars as reliable resources, which weeds out any social media websites, blogs, message boards, or any resource that may contain false or non-reliable information. This will save students the time of finding sources, and provide them more time to focus on content. Another time saving tool that is available, is that students can search a broad topic such as "energy", and the database will offer subtopics in that category to refine the search down to fewer articles for students to read. For students that struggle with reading difficult texts, Destiny also provides students with the reading level of each of

the resources listed. Once students find articles that are suitable for the topic they are research, they can save the resources to their username to refer to later.



Source: Destiny Catalog via school account



Source: Destiny Catalog via school account

1. The BIG CER

To the Teacher: The purpose of this lesson is to introduce students to using evidence and reasoning to make claims. The lesson can be modified in many different ways to meet the particular needs to the student. The technology used in this lesson is just a suggestion, but alternative types of technology can easily be supplemented. The format for forming an argument in this lesson will be used throughout future lessons.

Standards: This lesson can be used at anytime during the school year. It is a general introduction into creating arguments, and supporting it with evidence. There are no specific standards for this lesson.

Objectives:
Students will be able to support an answer to a question by using the acronym CER: Claim, evidence, and reasoning.

Essential Questions:
- What are the parts of a persuasive argument?

Time Needed: One 40-minute class period

Materials:
"CER Graphic Organizer", "CER Rubric", Ipad or computer

Procedure:

Engage:
Think-Pair-Share: Independently have students write a short paragraph answering the question, "How would you create a persuasive argument?" Once they have had an opportunity to write down some ideas, have them share their ideas with another student.

Explore:
Once students have had time to share ideas, promote a classroom discussion focusing on what makes a good argument. Some responses may include: facts, evidence, reasoning, and references. However, some students may try and use their personal opinions as arguments. If this happens, ask the class if they think that is a good way to make an argument, why or why not?

Make a provocative statement to the class to create discourse. For example, tell the students that "Katy Perry is the best singer in the world." Students will most likely try to argue over who is the best singer in the world. Use this opportunity to segue into using evidence and reasoning to support a claim.

Explain:

Introduce to the students the acronym “CER”, which stands for Claim, Evidence, and Reasoning. Provide the students with definitions of each, and model an example with the students using the graphic organizer.

Claim- A statement or conclusion that answer the original question/problem
Evidence- Scientific data that supports the claim.
Reasoning- A justification that connects the evidence to the claim (the glue).

Extend: Using an online forum created by the teacher on the Learning Management System Schoology, have students post one question on the discussion board. The student’s classmates will reply to each comment with a claim, three pieces of evidence, and reasoning to connect the claim to the evidence. The reasoning is basically the logical thinking behind an argument. For Example, if a student was trying to make the claim that they are the best academic student in school, but for evidence they state that they have the most goals on the schools soccer team, it doesn’t make logical sense. The evidence has to be relevant to the claim. A better piece of evidence would be that they are the best academic student in school because they have the highest GPA.

Evaluate: Ask the students to make a claim to the following question, “Who is a good Student?” and support it with evidence, and reasoning. Using the “CER Graphic Organizer” to answer the question. Teachers have the option to have students do this using pen and paper, or have students complete this electronically using an iPad or computer, and upload their completed graphic organizers to a LMS, in this case, Schoology.

Class Debate : CER Rubric

Teacher Name:

Student Name: _____

CATEGORY	4	3	2	1
Claim	Claim is accurate and complete	Claim is accurate but incomplete	Claim is incorrect and incomplete	Claim is not present
Evidence	Includes three lines of evidence the are relevant to the claim	Includes less than three line of evidence relevant to the claim	Includes less than three lines of evidence some of which are not relevant to the claim	Evidence is missing or is not relevant to the claim
Reasoning	reasoning clearly connects evidence to claim, including explanations of scientific principles related to the evidence	reasoning clearly connects evidence to claim, including partial explanation of scientific principles related to the evidence	incomplete connection between evidence and reasoning	Does not provide reasoning

Claim, Evidence, and Reasoning (CER)

Question:	
Claim (A statement that answers the question):	
Evidence 1: (Data that supports Claim)	Reasoning 1: (Connection between the evidence and the claim)
Evidence 2:	Reasoning 2:
Evidence 3:	Reasoning 3:

2. Is It Getting Hot in Here?

To the Teacher:

During this lesson students will explore the topic of climate change. This lesson is split into two days. On the first day, student's previous knowledge and misconceptions will be evaluated using an online quiz through NASA's explore quiz. Students will gain background knowledge on climate, and causes of climate change through an online webquest. As part of the webquest, students will graph CO2 levels and average global temperatures since the industrial revolution. The students will be evaluated based on their analysis of the data they graphed. As an extension for this lesson, students can calculate their carbon footprint using an online questionnaire.

Day two is focused on students conducting research to support a particular stance on the cause of climate change. Students will apply the research skills learned in the lesson "research 101" to investigate the cause of climate. The students will work in teams to collect evidence to support that climate change is either naturally occurring, or anthropogenic. The students will write short paragraphs that will include Claim, evidence and reasoning. The final product for day two will be a formal debate concerning the causes of climate change.

Students

Grade levels: 6-8
Skills: Forming arguments using the CER format discussed in lesson "The Big CER". Research skills using search engines as discussed in the lesson "Research 101".
Possible misconceptions: Climate vs. weather, and concepts surrounding climate change

Standards:

Standard 1: The student understands how anthropogenic sources of carbon dioxide emissions are exacerbating Earth's greenhouse effect, and thus contributing to global climate change.

Objectives:

- All students will be able to describe, and list possible causes of climate change
- Most Students will be able to analyze carbon level evidence and create discourse over the causes of climate change

Essential Questions:

- What is Climate Change?
- What are the major causes of climate change?
- Is Climate Change naturally occurring or anthropogenic?

Time Needed:

A minimum of two 40-minute class periods.
Day 1: Pre assessment, webquest, graphing activity, and carbon footprint calculator
Day 2: Research evidence, collaboration of evidence with classmates, organizing information into "CER graphic organizer", Climate change debate

Materials:
"CER Graphic Organizer", "CER Rubric", "Climate change webquest" worksheet, "What is your Carbon Footprint" Worksheet, "Anthropogenic vs. Non-Anthropogenic Climate Change Debate" worksheet, computer or other device with access to the Internet

Procedure:

Day 1-Introduce to Climate Change

Engage:
The purpose of the engage phase is to have students pre-assess themselves to find out what they already know about climate change, and any misconceptions that they may have. Based on misconceptions that students have, the teacher can make it a point to focus future activities around helping students overcome their misconceptions. The key idea behind this engage activity is that students will start to formulate questions, and build interest as they are introduced to a new topic.

Student Instructions: Using computers, ipads, or other electronic devices with access to the Internet, have students individually take the NASA's explore quiz to pre-assess students knowledge of temperature and climate change.

Link: http://climate.nasa.gov/interactives/quiz_global_temp/quiz

Go over the quiz as a class, or in pairs, having students focus on the questions they got wrong, and think about why they have the misconceptions that they have.

Explore:
One of the driving forces behind climate change is the Earth's CO2 level. During the explore activity; students will create visual representations to observe how the earth's CO2 levels have changed over time. Students will analyze the graph and create inferences based on the data later in class.

Student Instructions: Using computers, ipads students will look at the evidence presented on NASA's website for climate change. The students will graph data on carbon levels and temperature changes from the late 1800's.

Website: http://climate.nasa.gov/evidence/

Explain:
During the explain activity students will build a foundation of knowledge on climate change. The activity is student centered, and is driven by the student's curiosity to learn more about the concepts that they got incorrect on the pre assessment quiz. The questions the webquest are not complex, they are knowledge-based questions, giving

students the information that they will need to later apply in a debate. The students are getting the same information that could be given in a lecture, but in this case the webquest allows for more engagement and collaboration among students. The students should work in pairs to allow for collaboration and discussion of questions. See attached worksheet “climate change webquest”.

Evaluate: Using the graph that they created during the explore phase, and the information that they collected using the webquest during the explain phase. Students will apply knowledge to answer a ticket out the door question:

Ticket out the door: Based on your graph of CO2 levels and average global temperatures over time, and your knowledge of climate change, what inferences can you draw based on this data? Write one paragraph explaining what you can infer, and support that inference with three pieces of information from the webquest.

The students are forming inferences based on the data graphed. Basically, what the students should see is that as the CO2 levels increase, the temperature also increases. An inference would be that the increased CO2 levels are causing the increase in temperature. This is a summative assignment, and depending on the students responses will require a follow up lesson or intervention to help students with their misunderstanding.

Extend: If there is additional time at the end of the period, or you wish to have students explore their own personal impact on the world’s carbon levels, students may use an online carbon footprint calculator. The website bellow will have students answer simple questions about activities they do on an everyday bases. After students calculate their carbon footprint, they can go back through the questions and change their responses to see how they can reduce their carbon footprint.

Student instructions: Using computers, or ipads have students calculate their carbon footprint. The discussion questions can be posted on the Learning Management System, Schoology, or handed in as a hard copy. See attached worksheet.

Name_____
Section:

What is your Carbon Footprint?

GO to the following website:

http://calc.zerofootprint.net/

Once you can gone through with your original answers, go back through changing your answers (one at a time) to see how these changes can affect your carbon footprint.

Discussion Questions:

1. How did your level of carbon emissions compare to the average carbon emissions of people in other countries?
2. Why do some people call our total carbon emissions a "carbon footprint"?
3. Which category (transportation, home and school, what you eat, what you use, or what you throw away) do you think has the greatest effect on your carbon footprint? Why do you think it has the largest impact?
4. What are some ways you can reduce your carbon footprint? Which change is the easiest one to make? Will you try one of the things you learned from the carbon calculator?
5. How can you help others in your community to make similar changes to their carbon footprints?
6. Many people think that shrinking our footprint will improve our quality of life. How might we reduce our carbon emissions while improving our quality of life?

Name_____

Climate Change Webquest

Check it out: http://www.epa.gov/climate/climatechange/kids/basics/index.html

What is the difference between climate and weather?

What could rising global temperatures lead to? Why?

What is a green house gas?

How do we get green house gases?

Click on the green house gases link. What are the four major green house gases? And what percentage do each of them make up?

What are the six main sources of green house gas emissions (include percentages of each)?

Click on the link for the green house effect. Describe the green house effect. How does it cause our planet to warm up?

Click on the all about carbon dioxide link. What is carbon dioxide? Where does it come from? and how does it contribute to global warming? Where is carbon dioxide stored?

Go to the earth's climate in the past:

How old is the earth?

How has the climate changed in the past?

List and Explain natural factors that have changed the earth's climate in the past

Day 2: Now that students have a basic understanding of climate, carbon emissions, and possible causes of climate change, the students will conduct their own research, create arguments, and debate their classmates on the cause of climate change (Natural vs. Anthropogenic). Some students may not be familiar with how a debate is conducted. Some students may view a debate as arguing over a particular question trying to defeat their opponent or prove that they are right. Students will see that scientific debate is not about winning and argument; it is about creating explanations based on evidence to increase knowledge and further the understanding of the field of science.

Engage:
To gather the students interest in the topic, and to model how a debate can be run, show the students a video clip of Bill Nye debating Marc Morano on the topic of climate change.
Link: http://www.youtube.com/watch?v=gWT-EWKIR3M

After the video ask students questions to help them understand what makes a good argument.

Example questions:
Who do you think had a better argument? Why?
How did Bill Nye and Marc Morano try and one another that their claim on the cause of climate change is the correct one?
What type of questions did they ask each other?
What were something's they said during the debate that was not productive in forming a good argument?

Explore:
Use the video and discussion to transition the lesson into the debate activity that the students will be doing in class. For the debate, students will collect their own evidence, see the lesson "research 101" for instructions on how to effectively and efficiently collect relevant evidence on their topic. Split the class into two separate groups: Natural vs. anthropogenic causes of climate change.

For student Instructions refer to the attached worksheet "Anthropogenic vs. Non-Anthropogenic Climate Change Debate"

Explain:
The explain phase will be complete student centered. The role of the teacher in this activity is to answer clarification questions, and help guide students as they conduct their research. Resources will be shared between groups using shared Google documents. Students may share website links, articles, or post possible research questions. This is a shared space where each group can collaborate together. Each student is responsible for taking his or her research and writing five paragraphs, one web resource per paragraph. The paragraphs can be submitted using Learning Management Systems, such as Schoology, or turned in via hard copy. See "Anthropogenic vs. Non-Anthropogenic

Climate Debate" for more details on student work. Also refer to the "research report: climate change debate" rubric provided for grading the student's writing.

Evaluate: The students will be evaluated on both their written evidence, as well as their presentation of the evidence during the debate. It is recommended to set up the classroom to have two tables or rows of desks facing each other. This will change at atmosphere of the room, and encourage students to take the debate seriously.

For the debate, the class will be split into the two teams. To start the debate, each team will select a representative to introduce each of the teams. After introductions, each student will have one minute to share their evidence, starting with one team, and going to the other. After every student has shared, each team will have the opportunity to ask questions to the other team. See rubric for scoring student's participation in the debate.

Extend: If there is time at the end of the class period, it is a good idea to debrief the students on the debate. As the teacher, you can share any insight or observations you made about their debate. Ask students if the evidence presented by their classmates convinced any of them to change their view. If so, what about the evidence was convincing? Is there anything you would do differently next time to prepare for a debate?

Name_____
Section

Anthropogenic vs. Non-Anthropogenic
Climate Change Debate

Directions: You will collect evidence and information to support your side of the debate. All evidence should be research based, in other words, don't quote blogs, webboards, facebooks posts, etc. For every piece of evidence, you should be able to explain the concept behind the evidence. For example, if you say that CO2 extracted from ancient ice cores is much less than current CO2 levels in the atmosphere, you must be able to explain HOW and WHY the evidence is important to your side of the debate.

Please keep track of your evidence on the shared Google document that I made for each group. This will allow group members to communicate back and forth, and collect resources together.

Each student must submit FIVE resources along with a short write up (3-5 complete sentences) that:
_____EXPLAINS the resource
_____WHAT the evidence is
_____HOW it supports the claim.
Students must also submit any background science information that is needed to <u>understand</u> their evidence. Try and pace yourself, use your time well!

You must cite all resources using MLA format
Using this website, you can put the information into the citation generator, and it will create the citation for you.
http://citationmachine.net/index2.php?reqstyleid=1&mode=form&rsid=6&reqsrcid=MLAWebDocument&more=yes&nameCnt=1

Here are several websites to check out
http://www.pbs.org/teachers/stem/professionaldevelopment/025/
http://climate.nasa.gov/
https://spark.ucar.edu/earth-system-science-climate-change-perspective
http://www.aitse.org/climate-change-anthropogenic-or-not/
http://www.aps.org/policy/reports/popa-reports/energy/climate.cfm
http://search.ebscohost.com/

Research Report : Climate Change

Teacher Name:

Student Name: _____

CATEGORY	4	3	2	1
Evidence	provides 3 pieces of evidence in a clear concise summary, with no inferences.	Provides 2 pieces of evidence in summary, with no inferences.	Provides 1 piece of evidence in their summary.	Provides no evidence.
Support	Makes a clear connection between their evidence and claim (support for their side of the debate.)	Connects some of their evidence to support their claim.	Connection between the evidence and their claim is unclear	Does not make any connection between the evidence and their side of the debate.
citation	Complete and correct citation using MLA format.	Uses MLA format, but has 1 or 2 mistakes.	Uses MLA format, but contains more than 2 mistakes.	resource listed, but not in MLA form

2. Water, Water, Everywhere; But Not a Drop to Drink

To the Teacher:

This lesson may be taught as part of an environmental unit, or separately as a mini water unit. The focus of the lesson is to show students how important water is to life on earth, and how limited fresh drinking water is. Although a majority of the planet is covered in water, only 3% of all water on earth is fresh water, and of that water, we only have easy access to less than 1%. This lesson is divided into two days.

On the first day, students will model the distribution of water on earth. This model will not only engage students on the topic of water, but it will impress upon the students how little fresh water is available for human use. Students will then explore how much water they use on a daily basis using an online water calculator. Again, this will raise student's awareness of how much water they use. Now that the student's have a basic understanding of how valuable fresh water is, they will participate in a jigsaw activity to learn more information about the specific areas (ocean, aquifer, lakes & river, etc) where water is stored. Upon finishing their research and completing the questions on a specific water source (See attached worksheet jigsaw Activity: Water Distribution), students will share their information with their classmates so that all students have a complete set of information on water distribution. If there is extra time, as a way of differentiating, students may take the information they gathered in class today and create flowcharts using online software called "lucid chart".

Day two is focused on preparing the students to write a persuasive letter to the United States Government urging them to provide support for underprivileged countries that are experiencing the water crisis. Start of the lesson by engaging the students on with a video that visually shows the students areas that are currently suffering from the water crisis. Not only should this engage them, but also pull on their "heart-strings" as they see adults and children struggling each day just to get fresh water. After the video, students will conduct research using ipads or computer on countries that are experiencing the water crisis (See "Water Crisis Graphic Organizer"). Now that the students are equipped with information concerning the scarcity of fresh water, and the problems that certain countries are experiencing, the students will write a persuasive essay trying to convince the United States Government to assist these countries. To do this, students will have to clearly identify the problem, offer solutions, and explain why the U.S. should help other countries (See "proposal to congress: water crisis). If there is time at the end of the period, students may make a post on the class Learning Management System, asking one question about the water crisis, and replying to two questions that their classmates posted.

Standards:

Standard 2: The student understands the distribution and basic chemical properties of freshwater on Earth, as well as the basic ecology of freshwater ecosystems.

Standard 3: The student understands how and why water is essential for all life on Earth through the study of freshwater pollution and conservation.

Objectives:

- All Students will be able to describe how the earth's water resources are distributed.
- All Students will be able to create a persuasive argument to gain support for countries that are experiencing the water crisis.

Essential Questions:

- Who is responsible for taking care of freshwater resources?
- What are possible solutions to freshwater shortages?

Time Needed: A minimum of two 40-minute class periods
Day 1: Model of Earth's water distribution, water usage calculator, Research, Jigsaw activity presentations, Lucid Chart Visual
Day 2: Water crisis video, research, persuasive letter, online discussion forum

Materials:
1,000 ml beaker, five smaller beakers, Computer or other device with access to the Internet, "CER Graphic Organizer", "Jigsaw Activity: Water Distribution", "Water Jigsaw Rubric", "Water Crisis Organizer", "Proposal to Congress: Water Crisis"

Procedure:
Day 1: Students will be introduced to basic information on the distribution of water. The amount of water distribution will be modeled; student will calculate their water usage, and research specific water storage from around the world. Using Jigsaw activity, students will teach each other about where water is stored around the world.

Engage:
Start the class by asking students "where all the water in the world is stored?" Call on students for responses. After students have had an opportunity to answer, ask them "How much of this water is clean, or drinkable?" Again, call on students for responses to the question. Finally ask, "Do you think that there is a lot of available drinking water?"

Let's imagine that all of the water in the whole world is in a 1,000 ml beaker.

Model for students the distribution of water for the planet. Take a 1,000 ml beaker and fill it with water. This represents all of the water in the world. Show students the percentage for water distribution. Either have them calculate how much water each category would represent out of the 1,000ml beaker, or have it prepared.

Earth's Water sources
970ml- SALT WATER
30ml- FRESH WATER
22.8ml -Ice (Glaciers, Ice Bergs)
6.9 Ground Water

.102ml- lakes and rivers
.0111ml- water vapor

This model will really shock the students to see that the amount of freshwater is only 30ml out of a 1000 ml beaker! And of that small amount of freshwater, we only have access to a very small amount.

Explore: Now that the students have seen how much fresh water is actually available for human consumptions, the students will use an online water calculator to figure out how much water they use in a day. Using computers, ipads or other devices, students will calculate their household's weekly consumption of water using an online calculator.

Student Instructions: Using the ipads, go to "water use calculator" on the following website: http://www.saveourh2o.org/water-use-calculator Answer the questions to the best of your ability. After you are done think about the following questions, We will discuss as a class after.

Discussion questions:
How much water do you use on a day?
What activities use the most water?
Did anything surprise you?
What are some ways that you could reduce how much water you use?

Explain: Now that they have seen how water is distributed using the model, and have calculated how much water they use a day, students will have the opportunity to research the specific areas where water is distributed. The students will break into groups of six; each member from the group will become an expert in a specific source of water. Using computers, ipads or other devices with access to the Internet, students will research specific sources where water is stored in the water cycle and answer the questions located on the "Jigsaw Activity: Water Distribution" worksheet.

Student Instructions: See "Jigsaw Activity: Water Distribution" worksheet.

Evaluate:
Students will present the information that they have researched to their classmates. At the very end, every student will have the information for each part of the water cycle. This activity is all students centered, and the role of the teacher is clarification on any instructions or questions about water distribution. The student's will self grade, and will grade each other. See the attached "Water Jigsaw Rubric" worksheet. Students will provide an effort grade for each other and for themselves. They must also include evidence as to why they awarded someone a grade.

Extend:
If there is time at the end of the period, students will create visuals of the information that they researched today. This will be a good way to provide differentiation and allow

students to review the material that they covered in class.

Student Instructions: Take all of the information that was covered in class today and create a flow chart using Lucidchart to show how all of the water sources are connected through the water cycle. You must include every water source, and at least two pieces details each. You may organize the information anyway that you want. Go to: www.lucidchart.com

Name_____
Section:

Jigsaw Activity: Water Distribution

Directions: You and your classmates will be researching specific areas of water distribution around the world. Each person in your group will research a specific topic and become an "expert" in that area. Use the guided questions and the links bellow to conduct your research. Remember, after you are done, you will have to teach the information to your group members. If you have any questions ask one of your group members or the teacher.

1. Watershed

http://water.usgs.gov/edu/watershed.html

1. What is a Watershed?
2. How does water enter and exit a watershed?
3. How do humans use water?

2. Glaciers and Ice Caps

http://water.usgs.gov/edu/earthglacier.html

1. What is a glacier and icecap?
2. How do Glaciers affect the landscape?
3. What is the history of glaciers?

3. Lakes and rivers

http://water.usgs.gov/edu/earthrivers.html

1. What is a river?
2. What uses do rivers serve?
3. Where does the water from rivers come from?
4. Where does the water in rivers go?

http://water.usgs.gov/edu/earthlakes.html

1. What is a lake?
2. What are the different types of lakes? do any of them have salt water?
2. What uses do lakes serve?
3. What are the characteristics of lakes?
4. What are common environmental problems in lakes? Describe the problems

4. Oceans

1. What percentage of the earth's water ins in the ocean?
2. Describe how the volume of the oceans changes. Be specific
3. Describe how the oceans currents work.
http://water.usgs.gov/edu/watercycleoceans.html

5. Atmosphere
http://water.usgs.gov/edu/watercycleatmosphere.html

1. How does water get into the atmosphere? Where does this water come from?
2. How much does a cloud weigh? Explain

6. Aquifer

http://water.usgs.gov/edu/earthgwaquifer.html
http://water.usgs.gov/edu/earthgw.html

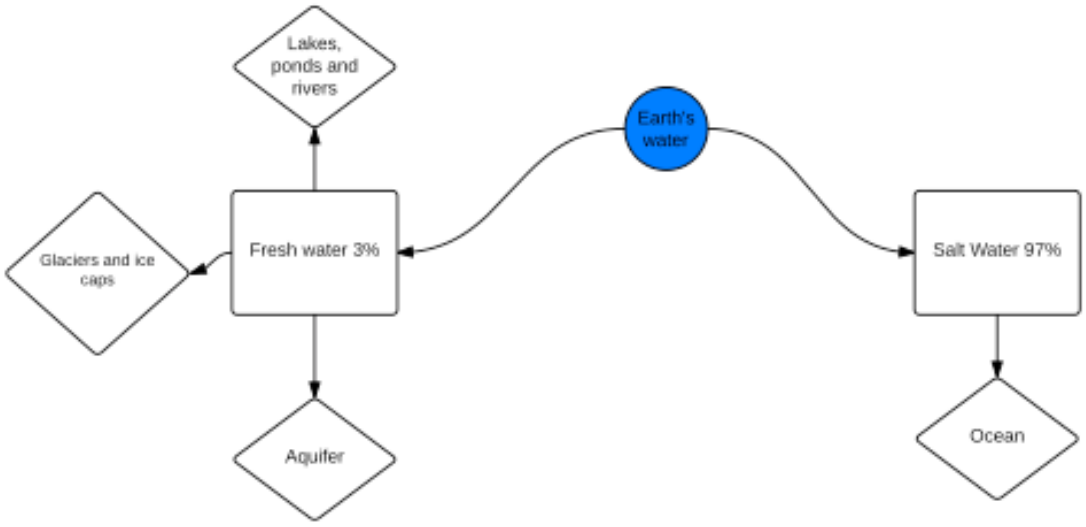
1. What is an aquifer?
2. How does the water get there?
3. How does the water get out?
4. What percentage of the world's water is there?

Name_____
Section:

Water Jigsaw Rubric

Student Name	Effort (1-4)	Evidence (What did they do to deserve this grade

Lucid Chart Graphic Organizer Example



Day 2: Now that students have an understanding of how the earth's water is distributed, and how scarce fresh drinking water is students will investigate current conditions of countries experiencing the water crisis. The final product for today's lesson will be a formal persuasive letter that the students will write to try to convince the United States Government to assist underdeveloped country that lack fresh water resources.

Engage:
Sometimes we can take fresh drinking water for granted, and we forget how precious it is. Even after seeing the water distribution model, it is hard to understand how people live that do not have access to clean water. Inorder for students to better understand what it is like to live in a country that is experiencing water scarcity show a short video clip that introduces students to the water crisis. This video may be hard for some students to watch as they see the unsanitary conditions, and the poverty that some people live in.

Link: "Water.org Unleashing the Power"
http://www.youtube.com/watch?v=KdwinEmUqF0#t=156

Explore:
Now that the students have witnessed with their own eyes the current conditions of several third world countries, and have seen their current water conditions, students will research specific countries that are experiencing water crisis.

Using computers, ipads, or other devices with access to the Internet, students will research the water crisis using www.water.org.

Student Instructions: See "Water crisis Organizer" worksheet.

Explain: The goal of the explain phase is to have students become more familiar with the conditions of countries experiencing the water crisis. Students will define the water crisis, explain why certain countries are experiencing a water crisis, and offer possible solutions to these problems. This activity is student centered, students may work in pairs to share research, but it is not necessary.

Students will fill in the "water crisis organizer" to help guide their research.

Evaluate: One of the skills that students need to become active members of society is the ability to make educated decisions, and form logical arguments based on evidence. The Students will write a persuasive letters to the United States Congress trying to convince the United States to provide aid for countries experiencing the water crisis. This graphic organizer that the students created earlier in class can be used to scaffold their writing.

Student Instructions: See attached "Proposal to Congress: Water Crisis " worksheet for more details. See attached rubric for information concerning grading.

Extend: As a way to get the students to discuss information found during their research, students will use a discussion forum on the schoology or any online forum to post discussion questions.

Student Instructions: Using an the water crisis thread created on schoology, post one question about the water crisis, and respond to two questions that a classmate posted.

Name_____
Section:

Water Crisis Organizer

Directions: Go to the website water.org. Answer the following questions based on the information on the webpage.

What is the water crisis? Describe the problem.

List the Five countries that are experiencing the water crisis are receive aid from Water.org. Explain why this country is considered to be in the water crisis?

1.

2.

3.

4.

5.

What are three possible solutions to the water crisis?

1.

2.

3.

Name_____
Section:

Proposal to Congress: Water Crisis

Directions: Gather research using the website www.water.org. Use the questions bellow to guide your research. Write a letter to the United States Congress trying to convince them that the U.S. should take a more active role in the water crisis. In your letter you should include:

Problem: Identify or define the water crisis and where it is occurring. Explain in detail what the problem is. Do not just say that they don't have enough water. Be specific!

Solution: What are possible solutions to the water crisis? List and explain at least three different possible solutions to the water crisis. These can be things directly related to the crisis like increased access to fresh drinking water, or indirectly like education programs.

Reasoning: Why should the United States help other countries that are experiencing the water crisis? This is the section where you bring all of your evidence presented above, and try to convince the government that they should help.

Persuasive Essay : Proposal to Congress: Water Crisis

Teacher Name:

Student Name: _____

CATEGORY	4 - Above Standards	3 - Meets Standards	2 - Approaching Standards	1 - Below Standards
Problem	Water crisis is clearly defined with detail, and including where it is occurring.	Defines water crisis without detail, includes where it is occurring	Water crisis is not clearly explained, and countries where it is occurring are not included.	water crisis not defined. No countries specified.
Solution	Includes three solutions with detailed explanations for each.	Includes three solutions with incomplete explanations	includes three solutions without explanation	Includes less than two solutions.
Reasoning	Clearly connects evidence to claim that the united states should assist countries experiencing the water crisis	Provides partial connection to evidence and claim	provides incomplete connection to evidence and claim	Provides no connection between evidence and claim.
Closing paragraph	The conclusion is strong and leaves the reader solidly understanding the writer\'s position. Effective restatement of the position statement begins the closing paragraph.	The conclusion is recognizable. The author\'s position is restated within the first two sentences of the closing paragraph.	The author\'s position is restated within the closing paragraph, but not near the beginning.	There is no conclusion - the paper just ends.

3. Nuclear Power?

To the Teacher: This lesson can be used as an individual unit, or it could be an extension to the climate change debate. There is flexibility in the length of this lesson, depending on how in depth the lesson goes into renewable resources. At the very minimum, two 40-minute periods are recommended, but this lesson could be extended to meet the needs of your classroom.
The purpose of this lesson is to provide the students with a background renewable and non-renewable energy sources. The final product for this unit is a debate on whether or not the United States should use nuclear power as a future energy source. On the first day, students will become familiar with the basic background information on energy and how it is created. The lesson starts by pre assessing student's knowledge. This will allow the teacher to uncover any misconceptions that students have, and what previous experiences they have with energy. Depending on student's previous knowledge and misconceptions, the lesson can be adjusted accordingly. The students will transition into a jigsaw activity, where students will research different types of energy and create presentations to share the information with their classmates. Students will take notes on their classmate's presentations using a graphic organizer.

Day two is focused on forming evidence-based arguments as to what type of energy the United States should invest in for future use. The students will watch a short TED talk where experts in the field of energy debate the positive and negatives of using nuclear power. This will model for the students how to form a good argument using quantitative data and other relevant pieces of evidence. The students will be divided into two groups pro nuclear power and con nuclear power. They will spend the rest of the class researching evidence and forming arguments for or against nuclear power. To scaffold the students, they will fill out the "CER Graphic organizer". The final assessment will be a formal debate (see attached rubric for details).

Standards:
S.8.4.1.3 The student will explain why carbon dioxide, among all greenhouse gases, is primarily responsible for causing the greenhouse effect.

Objectives:
- All student Students will be able to explain how nuclear power generates electricity including the positive and negative consequences.
- Most students will be able to form evidence-based arguments to either support or go against the use of nuclear power as a future source of energy.

Essential Questions:
- What is Nuclear Power?
- What are the benefits and consequences of using nuclear power as a potential energy source?
- What are possible sources of energy?

Time Needed: A minimum of two 40-minute class periods

Day 1: Pre assessment of student knowledge, think pair share, jigsaw activity, presentations, visual graphic organizers
Day 2: Ted Talk Video, research topics, organization of evidence, formal debate

Materials:
Access to the Internet, "CER Graphic Organizer", "Energy Research", "Energy Presentation Rubric", "Energy Debate"

Procedure:

Day 1: Students will pre assess their knowledge on energy; gain basic information on non-renewable and renewable energy sources by conducting researching and presenting to their classmates, and creating flow charts.

Engage: Energy is something that everyone is familiar with, and uses on an everyday bases. Waking up in the morning to the alarm clock, turning on the lights, driving to school or work. The purpose of this engagement activity is to see what students already know about energy and how it is created. It is important to identify student misconceptions early in the lesson so that they can be corrected.

Think-Pair-Share- Have students individually answer the question, "Where does energy come from?" Once they have had an opportunity to write down ideas, have them share ideas with a partner. Finally, generate a list of the ideas the students have come up with.

Explore: The students will work together in groups to research particular types of energy, including: a description of the energy, benefits and consequences of the energy, and whether or not they think it should be used as a future energy source (See "Energy Research" worksheet).

Jigsaw activity- Split the students into six groups, each group will be responsible for researching a particular energy source: Nuclear energy, solar energy, hydropower, wind power, geothermal, coal, and natural gas. The students will use the "Energy Research" worksheet to help scaffold their research. Refer to "Researching 101" in earlier lessons to help students conduct research.

Student Instructions: See "Energy Research" worksheet

Explain: After each group is done filling in the "Energy Research" worksheet, students will create a short PowerPoint or Prezi to share their information with classmates. The presentation must contain all of the information that was request on the "Energy Research" worksheet. The key feature is that students must explain whether or not the energy they researched should be used as a major source of future energy for the United States. Students will fill in their graphic organizer as their classmates present. Give students an opportunity to ask questions at the end of each presentation.

Evaluate: See attached rubric.

Extend:
If there is time at the end of the period, students will create visuals of the information that they researched today. This will be a good way to provide differentiation and allow students to review the material that they covered in class.

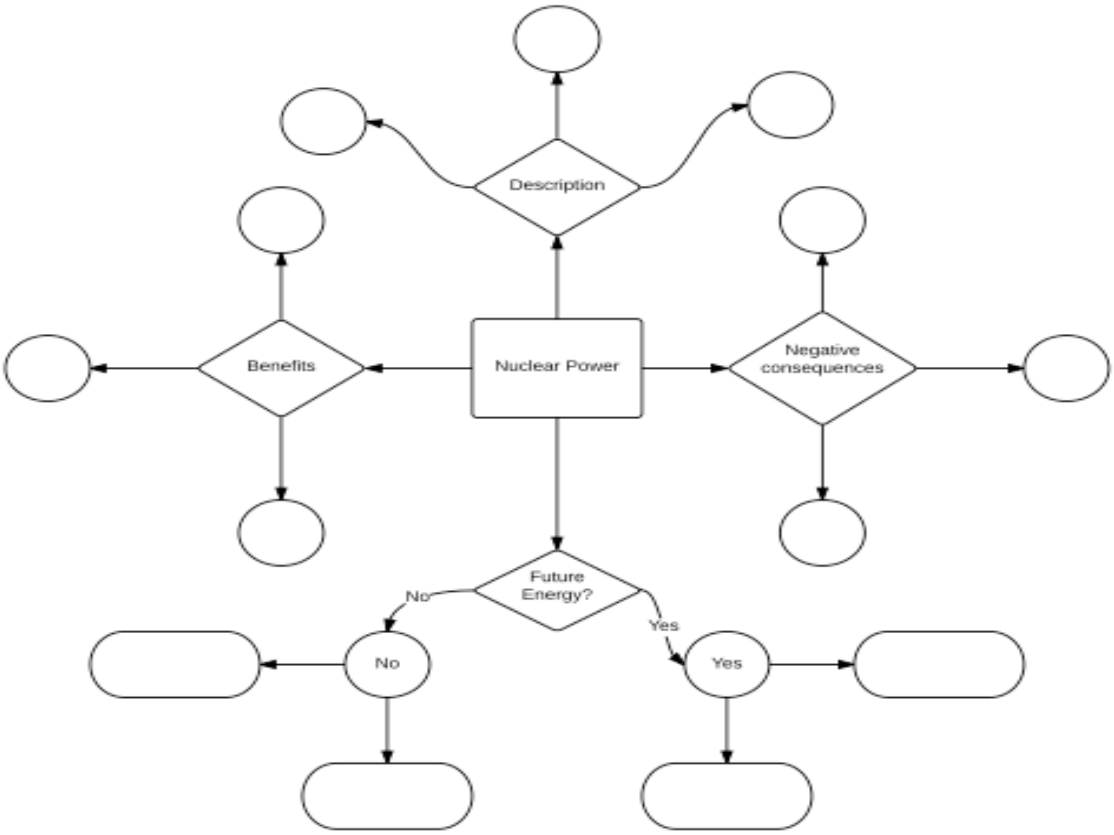
Student Instructions: Take all of the information that was covered in class today and create a flow chart using Lucidchart to show all the different ways that energy is created. You must include every type of energy, and at least two pieces details each. You may organize the information anyway that you want. Go to: www.lucidchart.com

Energy Research

Directions: As a group you will be researching a specific type of energy. Use the following graphic organizer to guide your research. After you have filled in your section of thegraphic organizer, create a short 3-4 minute presentation (PowerPoint, Keynote, Prezi). Use the website www.need.org/intermediate to find information on your topic. All of the types of energy are listed on the sidebar.

Type of Energy	Description of energy	Benefits of energy	Negative consequences	Should it be used as a future energy source?
Nuclear				
Solar				
Hydropower				
Wind				
Geothermal				
Coal				

Example Flowchart using Lucidchart



Research Report : Energy Presentation

Teacher Name: **Mr. Chichester**

Student Name: _____

CATEGORY	4	3	2	1
Content	All topics are addressed and all questions answered with at least 2 sentences about each.	All topics are addressed and most questions answered with at least 2 sentences about each.	All topics are addressed, and most questions answered with 1 sentence about each.	One or more topics were not addressed.
Quality of Information	Information clearly relates to the main topic. It includes several supporting details and/or examples.	Information clearly relates to the main topic. It provides 1-2 supporting details and/or examples.	Information clearly relates to the main topic. No details and/or examples are given.	Information has little or nothing to do with the main topic.
Future source of energy?	Provides a clear claim, with several pieces of logical evidence to support it.	Provides claim, with a few pieces of evidence to support it.	Makes claim, but does not have evidence to support it.	Does not make claim.

Day 2: Students will watch a short TED Talks video modeling for students a debate on nuclear energy from experts in the field. The students will research different types of energy, and form arguments as to whether or not the United States should use nuclear power as a major source of power for the future. The final assessment for this lesson will be a formal debate on the use of nuclear power in the future.

Engage: To gather the students interest in the topic, and to model how a debate can be run, show the students the Ted Talks " Debate: Does the World Need Nuclear Energy?" video.

After the video ask students questions to help them understand what makes a good argument.

Example questions:
Who do you think had a better argument? Why?
How did the debaters try and convince one another that their claim on the cause of perspective on nuclear energy is the best?
What type of questions did they ask each other?
What were something's they said during the debate that was not productive in forming a good argument?

Explore: Split the class into two teams. One team will be forming argument in support of Nuclear power for future energy, and the other team will be against the use of Nuclear power for future energy.

The question that the students will be debating is, "Should the United States Build Advanced Nuclear Power Facilities to Meet Future Needs?" The class will be divided into two groups: In support of Nuclear Power as a future energy source, and those against the use of nuclear power as a future energy source.

Student Instructions: See attached "Energy Debate" worksheet

Explain: The students will fill out three "CER Charts" with three different resources. Refer to the lesson "Research 101" for instructions on how to use destiny to conduct research. The students should have a total of nine pieces of evidence at the end of the research. There is a lot of flexibility for teachers to differentiate in this section. More advanced students can write paragraphs instead of filling out the graphic organizers, and students that need more support can fill out fewer graphic organizers.

Evaluate: The students will be evaluated on both their written evidence, as well as their presentation of the evidence during the debate. It is recommended to set up the classroom to have two tables or rows of desks facing each other. This will change at atmosphere of the room, and encourage students to take the debate seriously.

Debate: The class will be split into the two teams. To start the debate, each team will select a representative to introduce each of the teams. After introductions, each student will have one minute to share their evidence, starting with one team, and going to the other. After every student has shared, each team will have the opportunity to ask questions to the other team. See rubric for scoring student's participation in the debate.

Extend: Debrief the debate; ask students if the evidence presented by their classmates convinced any of them to change their view. If so, what about the evidence was convincing?

Name_____
Section:

Energy Debate

This debate is on the topic of energy usage. The question that is being considered is, "Should the United States construct a new generation of advanced nuclear power plants to meet our electricity needs?" Using your knowledge of climate change, and energy, you and your group will gather evidence to either support this question, or refute (go against). Each student must fill out a "CER" graphic organizer that is located on Schoology. Each student must have a minimum of three reliable sources (Not blogs, wikipedia, facebook, etc.). For each source, you must fill out the "CER" Graphic organizer. This will result in a total of NINE pieces of evidence with reasoning.

Claim, Evidence, and Reasoning (CER)

Question:	
Claim (A statement that answers the question):	
Evidence 1: (Data that supports Claim)	Reasoning 1: (Connection between the evidence and the claim)
Evidence 2:	Reasoning 2:
Evidence 3:	Reasoning 3:

Class Debate : Nuclear Energy

Teacher Name:

Student Name: _____

CATEGORY	4	3	2	1
Evidence	All information presented in the debate was clear, accurate and thorough.	Most information presented in the debate was clear, accurate and thorough.	Most information presented in the debate was clear and accurate, but was not usually thorough.	Information had several inaccuracies OR was usually not clear.
Understanding of Topic	The team clearly understood the topic in-depth and presented their information forcefully and convincingly.	The team clearly undestood the topic in-depth and presented their information with ease.	The team seemed to understand the main points of the topic and presented those with ease.	The team did not show an adequate understanding of the topic.
Use of Facts/Statistics	Every major point was well supported with several relevant facts, statistics and/or examples.	Every major point was adequately supported with relevant facts, statistics and/or examples.	Every major point was supported with facts, statistics and/or examples, but the relevance of some was questionable.	Every point was not supported.
Rebuttal	All counter-arguments were accurate, relevant and strong.	Most counter-arguments were accurate, relevant, and strong.	Most counter-arguments were accurate and relevant, but several were weak.	Counter-arguments were not accurate and/or relevant
Respect for Other Team	All statements, body language, and responses were respectful and were in appropriate language.	Statements and responses were respectful and used appropriate language, but once or twice body language was not.	Most statements and responses were respectful and in appropriate language, but there was one sarcastic remark.	Statements, responses and/or body language were consistently not respectful.

4. How Many Layers does it take to get to the Center of the Earth?

To the Teacher: This lesson can be taught during the geological unit, specifically when studying plate tectonics. One of the hot topics among scientists has been how the earth has changed over time. As it is impossible to observe what the earth was like in the past, scientists depend on indirect evidence to uncover the history of our planet. The purpose of this lesson is to have students piece together the evidence that has been gathered to support current theories on how the interior of the earth is structured. It is recommended that this lesson be taught over three days, to provide students time to research evidence, and draw conclusions based on that evidence.

On the first day, students will be pre assessed on what they already know about how scientists study the interior of the earth. Students will do an activity to explore how to study something that cannot be seen through using indirect evidence. After gaining basic knowledge of making inferences based on indirect evidence, the students will do an online webquest to see how scientists use seismic waves to study the interior of the earth.

One the second day students will be looking at evidence to support the theory of continental drift. The students will watch a rap battle Alfred Wegener vs. The Fixists to engage them in the topic. Students will try and generate ideas as to how the earth's continents could have spread apart, then they will look at the evidence that Wegener used to support his theory on continental drift. Students will record the evidence using a "CER" graphic organizer.

On the Third day, students will be looking at evidence to support the theory of sea floor spreading. The students will watch a clip from the science channel's "top 100 discoveries" to engage them in the topic. Students will look at evidence that Hess used to support his theory on sea floor spreading. Students will record the evidence using a "CER" graphic organizer.

Standards:
Standard 5: The student understands the how the Earth's interior is studied, its composition, and how processes within cause changes to Earth's surface.

Objectives:
- All students will be able to make predictions about earth's interior using seismic waves.
- Most students will be able to explain how ideas about earth's formation have changed over time as new evidence has been collected.
- Some students will use evidence to on continental drifting, sea floor spreading, and plate tectonics to make inferences on the Earth's interior.

Essential Questions:
- How do scientists study the inside of the earth?
- What does earth's interior look like?
- How has the earth's land distribution changed over time?
- What is sea floor spreading?

Time Needed: Three 40-minute class periods
Day 1: Think-pair-share, mystery box activity, seismic wave webquest, Ticket out the door.
Day 2: Rap battle video, class discussion, evidence exploration, CER graphic organizer, mini debate.
Day 3: Top 100 greatest discovery video, evidence exploration, CER graphic organizer, sea floor spreading simulation.

Materials: Computers, ipads, "CER Graphic Organizer", "Seismic Waves" worksheet

Procedure:

Day 1: Students will be working together in groups to form ideas about the interior of the earth, test these ideas, use online computer simulations, and generate explanations for the interior of the earth using indirect evidence.

Engage: Students will be pre assessed to see what previous experiences they have with the topic on geology. This is also a good time to find any misconceptions they may have on the topic, and provide appropriate intervention

Think-pair-share: Ask the students the following question, "How do scientists study the inside of the earth?" Give students a minute to write down any ideas they have, then one minute to share with a classmate. Probe students with questions to get them to think more deeply about the question. "Scientists have not been able to drill deep enough to actually see what the inside of the earth is like. How do you study something you can't see?"

Explore:
Break the students into pairs or small groups. Each group will receive a container that is wrapped so the students cannot see what is inside. Without opening the container, students will try and figure out what is inside. They must rely on their other senses and maker inferences based on what they observe.

Have students make predictions as to what is in their container. They must provide an explanation for their prediction.

After a few minutes, have the students open their containers and see if their predictions were right.

Student Instructions: See attached "Mystery Box" worksheet.

Explain: Explain to the students that scientists study the earth similar to the way that they just tried to predict what was inside your mystery container.
Now that the students have a basic understanding of using indirect evidence to form predictions on something they can't see, students will use computer simulations to

answer questions about how scientists study the earth using seismic waves. All of the information that the students will collect this lesson can be written directly on the "Seismic Wave" worksheet. The students will be actively searching for information, and generating ideas through interactive with the seismic wave simulator.

Student Instructions: See "Seismic Wave" worksheet

Evaluate: The evaluation for this lesson can be differentiated. Students may write a paragraph describing the current model of the inside of the earth, using evidence of seismic waves to support this model. Instead of writing, students may draw illustrations of the current model of the inside of the earth, using evidence of seismic waves to support the model. Or the student may create an alternative display. See "Earth's Inner Structure" rubric for details on grading.

Extend: If there is time at the end of the period have students trade their paragraph with a classmate and give them the opportunity to provide feedback to each other.

Name_____
Section

Mystery Box

Description: Inside each mystery box is a pattern molded in plastic. It is your job to determine the pattern without opening the containers. All observations will be done from the sense of touch and sound. You first job is to make a hypothesis of the pattern without playing with the container. Your second job is to make observations. Lastly, you will draw the actual pattern from the overhead. Remember all containers are different and you are not allowed to open the containers.

Number	Hypothesis Prior to Observing	Test Observations	Actual Given after
____			
____			
____			

Name_____
Section:

Seismic Waves

Directions: Go to the following website:
http://sunshine.chpc.utah.edu/Labs/SeismicWaves/

Use the interactive wave simulation to answer the following questions:

What are the three types of waves?

P waves
How do the P waves move? Up and down or side to side?

P waves (pressure or primary waves) travel as a region of compression. How would this appear? Using the diagram above, make the green dots move left and right. Observe what happens to the distance between the dots. During compression, the dots move:

A. closer together
B Further Apart

The wave is similar to the way that

A. Sound travels
B. Light travels

Through the air. As P waves travel, the green dots vibrate back in forth

A. parallel or
B. perpendicular

What type of rock do P waves travel through?

S Waves

S waves (shear waves) travel like vibrations in a bowl of Jello. How would this appear? Using the diagram above, make the green dots move up and down.

A. Does the distance between the green dots change or,
B. is the rectangular shape between the dots distorted?

The movement of the green dots is

A. Parallel or
B. Perpendicular

To the direction that the wave travels.

What wave is slower the S or the P wave?

What type of rock can the S wave travel through?

How does the P wave make rocks move?

Why can't an S wave travel through liquid rock?

How are P and S waves generated?

How do P and S waves travel? Is their speed constant?

As the wave travels away from its original source does it:

A. Speed Up
B. Slow Down

What happens to waves as it hits rocks of different density?

What happens to the waves at it travels through boundary layers of different rocks?

How do these wave behaviors help scientists understand what the earth's interior is constructed of?

Persuasive Essay : Earth\'s Inner Structure

Teacher Name:

Student Name: _____

CATEGORY	4 - Above Standards	3 - Meets Standards	2 - Approaching Standards	1 - Below Standards	0
Description of Model	Complete and accurate description of model, including details.	Complete and accurate description of model.	Partially complete description of model with minor errors.	Partial description of model with several errors.	No description of model.
Evidence	Includes complete and accurate explanation of evidence to support the model described. Scientific principles are explained.	Includes accurate evidence to support model described above.	Includes partial evidence to support model	Evidence is poor support for model described	does not include evidence
Reasoning/connect	Evidence is clearly connected to claim including explanations of scientific principles used to support the model.	Evidence is clearly connected to claim	Evidence is connected to model	connection between model is unclear	No connection is made between model and evidence

Day 2: Students will explore pieces of evidence to support Wegener's hypothesis on Continental Drift. The evidence will be organized using the "CER" graphic organizer, and students will hold a mini debate to discuss the evidence.

Engage: To gather student's interest in the topic of continental drift, show video "Alfred Wegener vs. The Fixists (continental drift) Scientific History Battle Rap"

Website: http://www.youtube.com/watch?v=hC1E93lTJbA

After watching the video, review the main concepts covered in the video by promoting discussion.

Use the following questions:
What was Wegener's Idea of continental drift?
What evidence was used to support continental drift?
Why didn't scientists at the time trust in Wegener's hypothesis of continental drift?

Explore:
Show the students a map of the world, or a globe of the earth.

Think-pair- share: ask the students, "How has the earth's land distribution changed over time?" Give them one minute to generate ideas, and one minute to share with a classmate. As a class, discuss the ideas that student's generated. Ask the students what they are basing their ideas on.

Explain: Students will work in small groups to look at evidence for continental drift, and make logical connections between Wegener's claim that all of the continents were previously connected, and that over time the continents separated.

Break the students into small groups (2-3); the students will look at provided evidence to support the hypothesis of continental drift.

Student Instructions: See "Continental Drift Evidence" worksheet

Evaluate: Students will use the "CER Graphic Organizer" to organize the evidence, and provide reasoning for Wegener's hypothesis on continental drifting. See attached "CER Rubric" for details on grading.

Extend: When Wegener first presented this idea of continental drifting, many scientists rejected this idea because Wegener could not explain the mechanism for how the continents separated. Divide the class in half, students will have a mini debate, one side of the debate will be the Fixists, and the other will be in support of continental drifting.

Class Debate : CER Rubric

Teacher Name:

Student Name: _____

CATEGORY	4	3	2	1
Claim	Claim is accurate and complete	Claim is accurate but incomplete	Claim is incorrect and incomplete	Claim is not present
Evidence	Includes three lines of evidence the are relevant to the claim	Includes less than three line of evidence relevant to the claim	Includes less than three lines of evidence some of which are not relevant to the claim	Evidence is missing or is not relevant to the claim
Reasoning	reasoning clearly connects evidence to claim, including explanations of scientific principles related to the evidence	reasoning clearly connects evidence to claim, including partial explanation of scientific principles related to the evidence	incomplete connection between evidence and reasoning	Does not provide reasoning

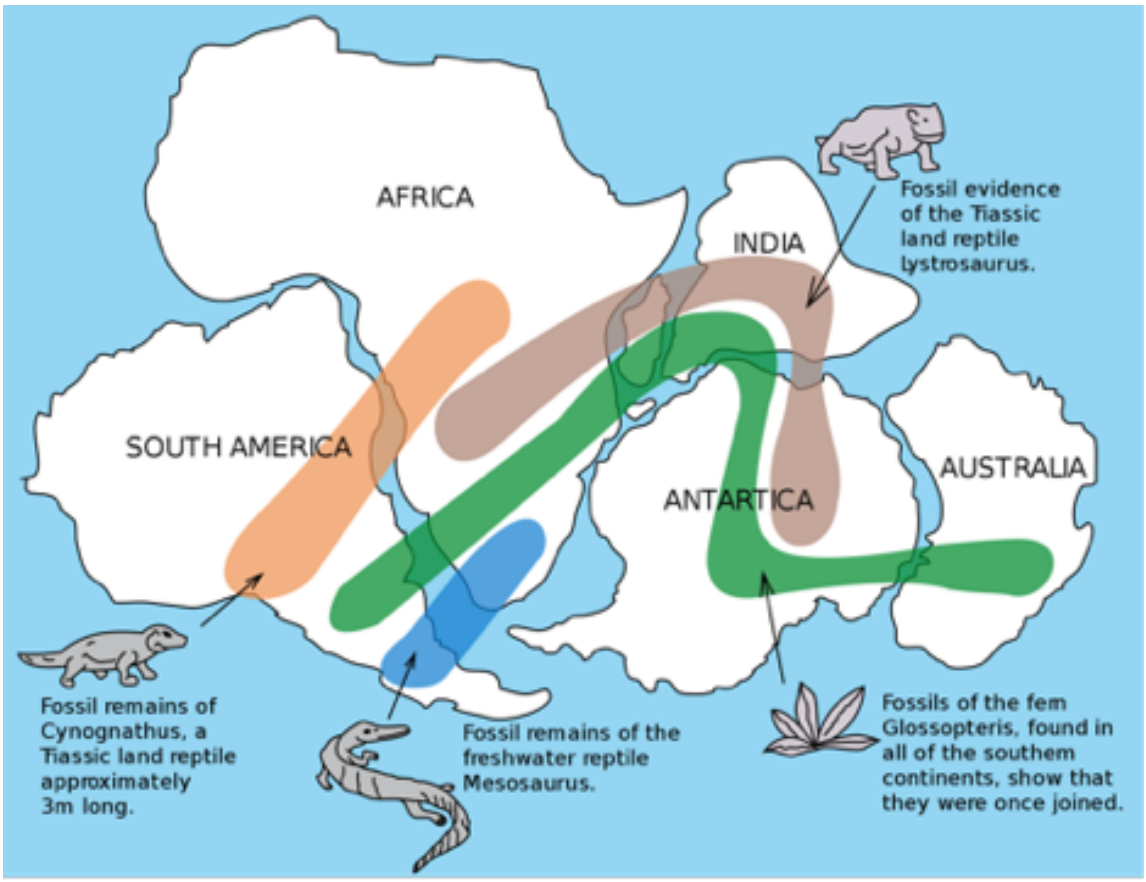
Continental Drift Evidence

Directions: Look at the evidence presented bellow. Using the "CER Graphic Organizer" connect the evidence presented to Wegener's hypothesis of continental drift.

Land Feature Evidence: mountains and other features on the continents provided evidence for continental drift. For example, when Wegener pieced together maps of Africa and South America, he noticed that mountain ranges on both continents line up. He noticed that European coalfields match up with coal fields in North America.

Fossil Evidence: Wegener also used fossils to support his argument for continental drift. A fossil is any trace of an ancient organism that has been preserved in rock. For example, Glossopteris (glaw sahp tuh ris), was a fernlike plant that lived 250 million years ago. Glossopteris fossils have been found in rocks in Africa, South America, Australia, India, and Antarctica. The occurrence of Glossopteris on these widely separated landmasses convinced Wegener that Pangaea had existed.

Other examples include fossils of the freshwater reptiles Mesosaurus and Lystrosaurus. These fossils have also been found in places now separated by oceans. Neither reptile could have swum great distances across salt water. Wegener inferred that these reptiles lived on a single landmass that has since split apart.



Climate Evidence:
As a continent moves toward the poles, its climate becomes colder. But the continent carries with it the fossils and rocks that formed at its previous locations. For example, fossils of tropical plants are found on Spitsbergen, an island in the Arctic Ocean. When these plants lived about 300 million years ago, the island must have had a warm and mild climate.

Geologists found evidence that when it was warm in Spitsbergen, the climate was much colder in South Africa. Deep scratches in rocks showed that continental glaciers once covered South Africa. Continental glaciers are thick layers of ice that cover hundreds of thousands of square kilometers. But the climate of South Africa is too mild today for continental glaciers to form. Wegener concluded that when Pangaea existed, South Africa was much closer to the South Pole.

Source: Padilla, 2011, p. 26-27

Claim, Evidence, and Reasoning (CER)

Question: How has the earth's land distribution changed over time?	
Claim (A statement that answers the question): At one point, earth's continents formed a supercontinent called Pangaea, and over time those contents have separated to what we have today.	
Evidence 1: (Data that supports Claim)	Reasoning 1: (Connection between the evidence and the claim)
Evidence 2:	Reasoning 2:
Evidence 3:	Reasoning 3:

Class Debate : CER Rubric

Teacher Name:

Student Name: _____

CATEGORY	4	3	2	1
Claim	Claim is accurate and complete	Claim is accurate but incomplete	Claim is incorrect and incomplete	Claim is not present
Evidence	Includes three lines of evidence the are relevant to the claim	Includes less than three line of evidence relevant to the claim	Includes less than three lines of evidence some of which are not relevant to the claim	Evidence is missing or is not relevant to the claim
Reasoning	reasoning clearly connects evidence to claim, including explanations of scientific principles related to the evidence	reasoning clearly connects evidence to claim, including partial explanation of scientific principles related to the evidence	incomplete connection between evidence and reasoning	Does not provide reasoning

Day 3: Students will explore pieces of evidence to support Hess' theory on sea floor spreading. . The evidence will be organized using the "CER" graphic organizer, and students understanding will be reinforced using an online simulation of sea floor spreading.

Engage: To gather student's interest in the topic of sea floor spreading watch a clip from the Science Channel's "100 Greatest Discoveries: Sea Floor Spreading"

Website: http://www.youtube.com/watch?v=k-_Z6p5cjKg

Promote discussion and recap the video with the following questions:
What is sea floor spreading?
What evidence was presented for sea floor spreading?
How did Hess collect evidence?

Explore: Students will simulate how sonar is used to map the sea floor. To do this, the students will play "bat and moth" to experience how a bat uses echolocation to visualize what is around them. One student will simulate the bat by blindfolding him or herself and using a loud rattle, while the other student simulating a moth will use a softer rattle. Every time the student simulating the bat shakes the rattle, the student simulating the moth must shake his or her rattle. The objective is the student playing the bat will "tag" the other student without using sight. This is similar to the game "Marco Polo", except the call and responses is with rattles.

Explain: Students will work in small groups to look at evidence for sea floor spreading, and make logical connections between Hess' claim that all of the sea floor is spreading.

Break the students into small groups (2-3); the students will look at provided evidence to support the hypothesis of sea floor spreading.

Student Instructions: See "Sea Floor Spreading" worksheet

Evaluate: Students will Use the "CER Graphic Organizer" to organize the evidence, and provide reasoning for the hypothesis on sea floor spreading. See attached rubric for details on grading.

Extend: To reinforce student understanding on sea floor spreading, students will use the sea floor spreading online simulation to review the evidence for sea floor spreading. The simulator offers students a chance to look at each step of sea floor spreading in a step-by-step manor. All the students have to do is follow along with the simulation, students may draw or describe in words what is occurring.
Link: http://www.bioygeo.info/Animaciones/SeafloorMagnet.swf

Sea Floor Spreading Evidence

Directions: Look at the evidence presented bellow. Using the "CER Graphic Organizer" connect the evidence presented to Wegener's hypothesis of continental drift.

Evidence From Molten Material

In the 1960s, scientists found evidence that new material is indeed erupting along mid-ocean ridges. The scientists dived to the ocean floor in Alvin, a small submarine built to withstand the crushing pressures four kilometers down in the ocean. In a ridge's central valley, Alvin's crew found strange rocks shaped like pillows or like toothpaste squeezed from a tube. Such rocks form only when molten material hardens quickly after erupting under water. These rocks showed that molten material has erupted again and again along the mid-ocean ridge.

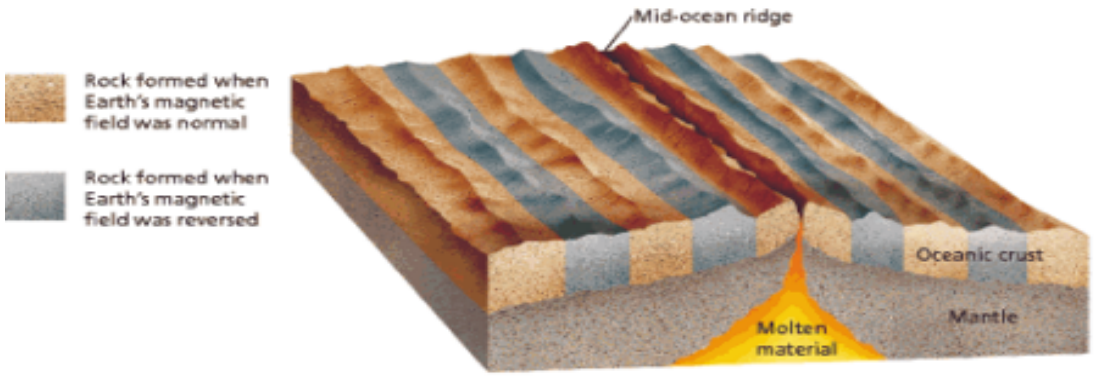
Evidence From Magnetic Stripes

When scientists studied patterns in the rocks of the ocean floor, they found more support for sea-floor spreading. You read earlier that Earth behaves like a giant magnet, with a north pole and a south pole. Surprisingly, Earth's magnetic poles have reversed themselves many times during Earth's history. The last reversal happened 780,000 years ago. If the magnetic poles suddenly reversed themselves today, you would find that your compass needle points south.

Scientists discovered that the rock that makes up the ocean floor lies in a pattern of magnetized "stripes." These stripes hold a record of reversals in Earth's magnetic field. The rock of the ocean floor contains iron. The rock began as molten material that cooled and hardened.

As the rock cooled, the iron bits inside lined up in the direction of Earth's magnetic poles. This locked the iron bits in place, giving the rocks a permanent "magnetic memory."

Using sensitive instruments, scientists recorded the magnetic memory of rocks on both sides of a mid-ocean ridge. They found that stripes of rock that formed when Earth's magnetic field pointed north alternate with stripes of rock that formed when the magnetic field pointed south. As shown in Figure 17, the pattern is the same on both sides of the ridge.



Evidence From Drilling Samples

The final proof of sea-floor spreading came from rock samples obtained by drilling into the ocean floor. The Glomar Challenger, a drilling ship built in 1968, gathered the samples. The Glomar Challenger sent drilling pipes through water six kilometers deep to drill holes in the ocean floor. This feat has been compared to using a sharp-ended wire to dig a hole into a sidewalk from the top of the Empire State Building.

Samples from the sea floor were brought up through the pipes. Then the scientists determined the age of the rocks in the samples. They found that the farther away from a ridge the samples were taken, the older the rocks were. The youngest rocks were always in the center of the ridges. This showed that sea-floor spreading really has taken place.

Source: Padilla, 2011, p. 18-21

Claim, Evidence, and Reasoning (CER)

Question: What force is strong enough to move the continents?	
Claim (A statement that answers the question): The sea floor is spreading, and as a result, pushing the continents apart.	
Evidence 1: (Data that supports Claim)	Reasoning 1: (Connection between the evidence and the claim)
Evidence 2:	Reasoning 2:
Evidence 3:	Reasoning 3:

Class Debate : CER Rubric

Teacher Name:

Student Name: _____

CATEGORY	4	3	2	1
Claim	Claim is accurate and complete	Claim is accurate but incomplete	Claim is incorrect and incomplete	Claim is not present
Evidence	Includes three lines of evidence the are relevant to the claim	Includes less than three line of evidence relevant to the claim	Includes less than three lines of evidence some of which are not relevant to the claim	Evidence is missing or is not relevant to the claim
Reasoning	reasoning clearly connects evidence to claim, including explanations of scientific principles related to the evidence	reasoning clearly connects evidence to claim, including partial explanation of scientific principles related to the evidence	incomplete connection between evidence and reasoning	Does not provide reasoning

5. I Want to Rock Right Now

To the Teacher: This lesson can be taught during the rock cycle unit. The focus of this lesson is to have students use evidence and reasoning to explain how the rock cycle model created. As a rock can take millions of years to travel through the rock cycle, scientists must use models and rely on indirect evidence to draw inferences. The rock cycle is a model that demonstrates how rocks transform from one kind to another over long periods of time. Through this lesson, students will explore different types of rocks as they collect evidence to generate ideas as to how rocks transform from one kind to another.

Standards:
Standard 6: The student knows what minerals are, how they are formed and classified, and understands their importance to humans.
Standard 7: The student knows what rock are, how they are classified, and understands how they cycle through the Earth.

Objectives:

- All students will be able to define and describe rocks and minerals
- Some students will be able to create inferences using evidence about how rocks change as the go through the rock cycle

Essential Questions:
What are rocks and minerals?
How do rocks form?
What evidence supports that rocks form through a cycle?

Time Needed: One 40-minute class period.
Day 1: KWL Chart, rock observation, Rock Jigsaw, rock identification

Materials: Computers, ipads, rock samples (optional), igneous, metamorphic, and sedimentary worksheets

Procedure:
Day 1: Students will be pre assessed to see what they already know about rocks and minerals. Students will explore different types of rocks to make observations, and create inferences about how rocks are formed based on evidence of the rock cycle. After the lesson, students will be assessed by categorizing rocks based on observational evidence.

Engage:
Pre assess what students already know about rocks by having them create a KWL chart to categorize what they know, what they want to know, and then after the lesson they will fill out what they learned. Have students create a KWL chart about rocks and minerals. See attached "KWL" worksheet. A digital alternative to the worksheet is to have student use a KWL creator, which can be found at the following, website: http://www.readwritethink.org/files/resources/interactives/kwl_creator/

Promote discussion using the following questions:
What are rocks and minerals?
How do they form?
How can rocks be classified?

Explore: One form of evidence that scientists use to create explanations of natural phenomenon is observations. The students will explore the three main types of rocks: Igneous, Metamorphic, and Sedimentary rocks.
Students will look at sample rocks and make observations about similarities and difference between them. When the students make their observations, it is important to NOT have the rocks labeled. The students will go back later and try and identify them.

Students may attempt to categorize the rocks based on their observations.

If a rock collection is not available, students can look at different pictures of the rocks.

Student Instructions: Using the rock samples provided by the teacher to make observations of the differences and similarities between rocks. Once you have made your observations, try and categorize the rocks based on those observations.

Explain: Students will use ipads and/or computers to research the different types of rocks and share the information in a Jigsaw activity.

Jigsaw Activity: Break Students into groups of three. Each member of the group will become an expert on a specific type of rock: Igneous, Metamorphic, or Sedimentary. Each student will be responsible for filling out an "expert worksheet" that they will share with their group mates. The students will find the information to the worksheets by researching using ipads, computer, or other electronic devices with access to the Internet.

Student directions: Using ipads, you research a particular type of rock (igneous, metamorphic, sedimentary) and become an "Expert". You will use the provided worksheets to guide your research. After you are done researching and have completed the worksheet, you will teach your classmates about the rock type you researched.

Evaluate: Students will go back to the rock samples and try to identify the rocks using the information they have gained working in their groups. Students must provide evidence and reasoning to support their classification of a rock . See answer key for grading.

Extend: Now that the studetns have had a chance to make observations of rocks, research different types of rocks, and identify rocks based on the characteristics they have researched have students fill out the last Colum in their KWL chart, what they learned.

Rocks and Minerals

K	W	L
(What you Know)	**(What you want to know)**	**(What you learned)**

Name_____
Section:

Igneous Rock

Description of how it is formed:

Igneous rocks are classified by their origin, texture, and mineral composition

Origin: Where do they come from?
Extrusive:

Intrusive:

Texture: How do they feel?

Mineral Composition: What is it made out of?

Draw a picture of an igneous rock

Sedimentary Rock

What is the process of erosion, deposition, compaction, and cementation? How does this process form sedimentary rock?

There are three types of sedimentary rock: Clastic, organic, and chemical. Describe each type of rock and draw a picture.

Clastic

Organic

Chemical

Metamorphic Rocks

How are metamorphic rocks formed?

Metamorphic rocks are classified according to the arrangement of grains that make them up.

Describe and draw the different types of metamorphic rocks bellow:

Foliated Rocks

Non-Foliated Rocks

Sample A:
This is a _____ Rock

Evidence:
1.
2.
3.

Sample B:
This is a _____
Rock

Evidence:
1.
2.
3.

Sample C:
This is a _____
Rock

Evidence:
1.
2.
3.

Answer Key

Sample A:
This is a Igneous Rock

Evidence:
1. Crystal Size (extrusive)
2. Texture is Course
3. Mineral Composition (quarts, potassium fieldspar)

Sample B:
This is a Metamorphic Rock

Evidence:
1. Banding (Foliated)
2. Mineral Grain Rearrangement (parallel lines)
3. Formed by heat and pressure

Sample C:
This is a Sedimentary Rock

Evidence:
1. Clastic rock (made of pieces of other rock)
2. Formed from compaction and Cementation
3. Texture

6. Where is Our Place in the Universe?

To the Teacher: This lesson can be taught as part of the Astronomy unit. The purpose of the lesson is to have students think critically about the evidence that supports our current model of planetary motion. Our place in the universe has been one that has caused controversy in the past. With the invention of the telescope and advances in technology, society has gone from the geocentric theory to the heliocentric theory. During this lesson, students will explore why it was previously believed that the earth was the center of the solar system, and how new evidence has changed our view to a sun-centered one. The lesson is split into to days, but can be adjusted according to the needs to the teacher and students.

On the first day, students will explore the current model of planetary motion, and research evidence that supports this model. Students will also investigate previous models of planetary motion, and explain how new evidence has changed the old geocentric model to the current heliocentric model.

Standards:
Standard 8: Astronomy-The student investigates the relationship between the planets and the sun in our solar system.

Objectives:
- All students will be able to describe the current model of planetary motion.
- Some Students will collect evidence, gain and apply knowledge of planetary motion in the universe while participating in a debate of heliocentric and geocentric theories.

Essential Questions:
- What is the current model of planetary motion? How has it changed over time?
- How has human's perception of our place in the universe changed?

Time Needed: Two 40-minute class periods
Day 1: Think-Pair-Share, Planetary computer simulation, Research Geocentric vs. Heliocentric evidence
Day 2: Debate Geocentric vs. Heliocentric Theory

Materials: Computers, ipads, and the "CER Graphic Organizer"

Procedure:
Engage: The engage activity is a way for the teacher to pre assesses what students already know about planetary motion, and to identify any misconceptions students may have.

Think-Pair-Share: Ask the students, "How do the planets and sun travel around the universe?" Give the students one minute to generate some ideas, and one minute to share with their neighbor. After students have had time to discuss, call on a volunteer to share

his or her answer. Most likely the student will say that all of the planets travel around the sun. Have students raise their hand if they agree, or if they have any other ideas.

Ask the students "how do you know that the sun is at the center of the solar system?"

Write responses on the board for students to see.

Explore: Give students the opportunity to explore an interactive model of the solar system. Through this model, students can manipulate how the planets move around the solar system. Ask the students, "Why do you think that it was previously thought that the earth was the center of the solar system?"

Website: https://www.khanacademy.org/partner-content/nasa/measuringuniverse/spacemath1/p/interact-models-of-the-solar-system

Student directions: Using the online planetary simulator, explore how the planets move in our solar system. Based on our perspective from earth, why do you think it was previously thought that the earth was the center of the solar system?

Explain: The students will research using ipads and/or computers to look for evidence to support both the geocentric and heliocentric model.

Split the students into at least two groups. One group will be responsible for searching for evidence to support the geocentric theory, and one group will be responsible for researching evidence to support the heliocentric theory. They will fill in the "CER Graphic organizer" as they collect data. To differentiate among students, more advanced students may write paragraphs to summarize the evidence and connect it to their claim, while students that need more assistance can use the graphic organizer and gather less evidence.

Student Directions: See "heliocentric vs. Geocentric Debate" worksheet.

Day 2: Today will focus on having students form evidence based arguments with their classmates in an attempt to come up with the best explanation for planetary motion.

Evaluate: The students will be evaluated on both their written evidence, as well as their presentation of the evidence during the debate. It is recommended to set up the classroom to have two tables or rows of desks facing each other. This will change at atmosphere of the room, and encourage students to take the debate seriously.

The students will have a debate in class, the heliocentric vs. the geocentric theory. The class will be split into the two teams. To start the debate, each team will select a representative to introduce each of the teams. After introductions, every student will have one minute to share their evidence, starting with one team, and going to the other. After every student has shared, each team will have the opportunity to ask questions to the other team. See rubric for scoring student's participation in the debate.

Extend: If there is extra time at the end of the period students will solidify their understanding of planetary motion by creating models. To increase the difficulty of the model, students can add moons.

Heliocentric vs. Geocentric Debate

Directions: You and your classmates will be having a debate on how the planets and sun travel in our solar system. One team will collect evidence to support the geocentric theory, and one will collect evidence to support heliocentric theory. Be prepared to have an answer and question section.

Question: How do the earth, the sun, and all of the planets in our solar system travel?	
Claim (A statement that answers the question):	
Evidence 1: (Data that supports Claim)	Reasoning 1: (Connection between the evidence and the claim)
Evidence 2:	Reasoning 2:
Evidence 3:	Reasoning 3:

Class Debate : CER Rubric

Teacher Name:

Student Name: _____

CATEGORY	4	3	2	1
Claim	Claim is accurate and complete	Claim is accurate but incomplete	Claim is incorrect and incomplete	Claim is not present
Evidence	Includes three lines of evidence the are relevant to the claim	Includes less than three line of evidence relevant to the claim	Includes less than three lines of evidence some of which are not relevant to the claim	Evidence is missing or is not relevant to the claim
Reasoning	reasoning clearly connects evidence to claim, including explanations of scientific principles related to the evidence	reasoning clearly connects evidence to claim, including partial explanation of scientific principles related to the evidence	incomplete connection between evidence and reasoning	Does not provide reasoning

7. Lets Take a Ride on the Milky Way

To the Teacher: This lesson can be taught as either an introduction to space exploration in the Astronomy unit, or as a final project. The purpose of this lesson is to get students to think about the impact the NASA space program has had on science, and society as a whole, and create a persuasive essay for the United States Government to continue to support NASA.

Over the past few decades, the United States has invested billions of dollars into the NASA space program. Some argue that the money invested in the space program could be better used here on earth. In this lesson, students will research the space program and make a decision whether or not space program should continue to be funded.

Standards:

Standard 9: Astronomy-The student understands the systems of classification for and major characteristic of the principle celestial bodies of the universe.

Objectives:

- All students will research pros and cons of the NASA space program
- All students will write a persuasive essays using evidence to convince the United States Government to either increate the space programs budget, or cut the budget to be used for other funds.

Essential Questions:

- Should the United States financially support the NASA space program?

Time Needed: One 40-minute class period
Day 1: Video, Think-Pair-Share, Budget article, Research, Persuasive essay
Materials: computer, ipads, "CER Graphic Organizer"

Procedure:

Day 1: In this lesson, students will look at the social aspect of making an argument. The evidence involved in making decisions and forming arguments are not always qualitative and in involve complex social and cultural factors. During the lesson students will conduct research, make decisions, and write a persuasive letter to the government.

Engage: Show students a short youtube video of Neil deGrasse Tyson "We Stopped Dreaming"
Link: https://www.youtube.com/watch?v=CbIZU8cQWXc

Think-Pair-Share: Give students one minute to respond to the following question individually, and then have them share ideas with a classmate "Do you think that the United States should continue to fund the NASA space program? Why or Why not?"

As a class discuss student responses. Write Pro's and Con's of the space program on the board in the front of the classroom.

Explore:
Have students look at NASA's 2015 Budget Estimates and see how much funding NASA receives from the U.S. Government and how much funding NASA is requesting to maintain operations.
Link: http://www.nasa.gov/sites/default/files/files/508_2015_Budget_Estimates.pdf

Guiding questions while reading:
How much funding NASA receives?
What percentage of the US budget is NASA?
How is NASA's fund allocated?

Explain: During this phase, students will get the opportunity to research what the NASA space program has done since its creation, and see how it has changed over time.

Students will conduct research on the history of NASA, and how space exploration has helped to make advances in science. This may include technologies developed, organizations spawning from NASA, extraterrestrial studies, data collected by NASA, and future plans by NASA.

Break the students into small groups (2-3) to collaborate on their research. Each member can share their resources using shared google documents, or they may choose to create a discussion forum on schoology. The students will then use the research to write a persuasive letter to the government.

Evaluate:
Students will write a letter to the United States Government urging the government to either continue supporting the space program in the name of science, or cut funding. The students must discuss what NASA has done in the past, and what its future plans are. The letter must also contain three pieces of evidence to support the student's claim concerning NASA's funding. To scaffold this assignment, have students fill out a "CER Graphic Organizer" with evidence to support their claim. See attached rubric for specifics on grading.

Student Directions: See "NASA Letter" worksheet

Name_____
Section:

NASA Letter

Directions: You will be writing a letter to the United States Government to persuade them to continue providing support to the NASA space program, or to cut funding. For your letter you must provide a compelling argument. To assist you in this, you must fill out a "CER Graphic Organizer" with three pieces of evidence and reasoning. Use the research that you gathered in your small groups to formulate the argument. See rubric for grading details.

Claim, Evidence, and Reasoning (CER)

Question: Should the United States continue to support the NASA space program?	
Claim (A statement that answers the question):	
Evidence 1: (Data that supports Claim)	Reasoning 1: (Connection between the evidence and the claim)
Evidence 2:	Reasoning 2:
Evidence 3:	Reasoning 3:

Class Debate : CER Rubric

Teacher Name:

Student Name: _____

CATEGORY	4	3	2	1
Claim	Claim is accurate and complete	Claim is accurate but incomplete	Claim is incorrect and incomplete	Claim is not present
Evidence	Includes three lines of evidence the are relevant to the claim	Includes less than three line of evidence relevant to the claim	Includes less than three lines of evidence some of which are not relevant to the claim	Evidence is missing or is not relevant to the claim
Reasoning	reasoning clearly connects evidence to claim, including explanations of scientific principles related to the evidence	reasoning clearly connects evidence to claim, including partial explanation of scientific principles related to the evidence	incomplete connection between evidence and reasoning	Does not provide reasoning

9. It's All Living and Connected

To the Teacher: This lesson can be taught during the ecology or environmental impact unit. The purpose of this lesson is to have students think about their role as a member of a community, and how important informed decision-making is. Everything on this planet is connected, and everything we do has an impact on the environment around us. As future citizens, students will need to make informed decisions on important issues. Through this lesson, students will gain an appreciation for the interdependence of all living organisms on this planet, as well as an understanding for collecting evidence to make informed decisions. This lesson is split over two days. On the first day, students will generate ideas concerning the impact a new superstore will have on their community. The students will each represent a different stakeholder in the community as they form arguments to either support or not support the building of a new "Mall-Mart". The final product will be a presentation to a mock town board, where they will present their stance on the issue, and support it with evidence.

Standards:

Standard 1: The student understands that all life on Earth can be organized into ecosystems of varying size that can be studied as closed systems, yet which are intrinsically interdependent.

Objectives:

Learning Target:

- All Students will use evidence to make informed decisions on an issue in the community

Essential Questions:

- What impact would building a large store have on a community?

Time Needed: Two-40 minute class periods
Day 1: Think-Pair-Share, Research
Day 2: Mock town board meeting

Materials: Computers, ipads, "CER Graphic Organizer", poster board

Procedure:

Day 1: Students will make decisions about the construction of a new Mall-Mart in their neighborhood. They will weight the costs and benefits of such a project, and make decisions based on evidence.

Engage: Have students start to generate ideas about a "real life" issue that could occur in their neighborhood, and what kind of decision they as members of this community with make.

Think-pair-share: Tell the student's that a new store similar to Wal-Mart is interested in coming to their community. Take one minute to generate ideas as to how this store would impact your community. Take one minute to share ideas with a classmate. As a class, discuss different ideas that were generated, write them on the board for the students to see. Guide discussion with the following questions:

What are the benefits?
What are the consequences?
Do you think the new store should be built?
What factors do you look at when making this decision?
What factors are the most important to you when making this decision? Why?

Explore: Split the students into groups of three or four, this will allow for collaboration and sharing of research. Assign each group a role from the attached "Town Board Meeting: Mall-Mart" Worksheet.

Students will participate in a mock town board meeting, as they create persuasive arguments to persuade the town board to either support or not support the building a new chain store "Mall-Mart."

Student Instructions: See attached "Town Board Meeting: Mall-Mart" Worksheet.

Explain: Students will conduct research using ipads, and computers to generate evidence to convince the board members to support their viewpoints.

Each member can share their resources using shared Google documents, or they may choose to create a discussion forum on schoology. The students will then use the research to write a persuasive letter to the government.

Students will organize their evidence in a "CER graphic Organizer" and create posters to present their argument for or against the new Mall-Mart in a mock town board meeting.

Day 2: Now that the students have gathered evidence and have organized it into a comprehensive argument, the students will present their argument to a town board.

Evaluate: Students will fill in their "CER Graphic Organizer" with the evidence and reasoning that they collect, along with a poster to present to the "town board." When the students present, get the community involved by inviting administration, other teachers, or parents come in to play the town board members. See "Town Board Meeting" Rubric and "CER Rubric" for details on grading.

Extend: One key feature of using argumentation and discourse discussing the evidence and trying to form the best solution. After presenting to the "town board" the students will have a chance to ask questions and rebuttal to their classmate's arguments.

Town Board Meeting: Mall-Mart

Directions: The CEO of Mall-Mart wants to build a store in your neighborhood. They are planning on clearing out a nearby forest to make room for the new store and its parking lot. Before the store can be built, it must receive permission from the town board. You and your classmates will represent a particular group within the community. Your goal is to provide a persuasive argument to convince the town board to either support or not support the building of the new store. Using Internet resources, you will research particular pieces of evidence to support your viewpoint. Fill in a "CER Graphic Organizer" with your evidence and reasoning. After, you will create a poster to present your evidence to the town board. Be prepared to answer questions about your side of the argument.

Role Cards:

Local Business (Con)- If the new Mall-Mart is built it will reduce customers for small town local business.

Economist (Pro)- If the new Mall-Mart is built, it will help drive the town's economy by providing jobs.

Environmentalist (Con)- If the new Mall-Mart is built, it will destroy an ecosystem where many animals live.

Family (Pro)- The new Mall-Mart can provide jobs, and offer lower prices on goods.

Claim, Evidence, and Reasoning (CER)

Question: Should a new Mall-Mart be built in your neighborhood?	
Claim (A statement that answers the question):	
Evidence 1: (Data that supports Claim)	Reasoning 1: (Connection between the evidence and the claim)
Evidence 2:	Reasoning 2:
Evidence 3:	Reasoning 3:

Oral Presentation Rubric : Town Board Meeting

Teacher Name:

Student Name: _____

CATEGORY	4	3	2	1
Role	The role and stance on the issue is clearly stated with supporting detail.	The role and stance on the issue is stated.	The role and stance on the issue is unclear.	The role and stance is not stated in the presentation.
evidence	Three pieces of evidence that are relevant to the issue are clearly stated.	three pieces of evidence that are relevant to the issue are stated.	Less than three pieces of evidence are presented on the issue.	The evidence does not support the issue being presented.
Poster	Poster is appealing to the eye, is organized, and contains all pieces of evidence.	poster is organized and contains all pieces of evidence.	Poster is not well organized and difficult to understand.	Poster is not well organized and is missing several pieces of evidence.
Question and Answer	Is able to answer questions in a way that is logical and provides feedback.	Is able to answer the question	struggles to answer the question in a coherent manner	Does not answer the question
Content	Shows a full understanding of the topic.	Shows a good understanding of the topic.	Shows a good understanding of parts of the topic.	Does not seem to understand the topic very well.

Class Debate : CER Rubric

Teacher Name:

Student Name: _____

CATEGORY	4	3	2	1
Claim	Claim is accurate and complete	Claim is accurate but incomplete	Claim is incorrect and incomplete	Claim is not present
Evidence	Includes three lines of evidence the are relevant to the claim	Includes less than three line of evidence relevant to the claim	Includes less than three lines of evidence some of which are not relevant to the claim	Evidence is missing or is not relevant to the claim
Reasoning	reasoning clearly connects evidence to claim, including explanations of scientific principles related to the evidence	reasoning clearly connects evidence to claim, including partial explanation of scientific principles related to the evidence	incomplete connection between evidence and reasoning	Does not provide reasoning

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