



Reading and Recording History of Urban Ecosystems

Kim Mayes, 2018 CTI Fellow
Cochrane Collegiate Academy

This curriculum unit is recommended for:
6th and 8th Grade Integrated Science

Keywords: ecosystems, abiotic factors, biotic factors, population factors, symbiotic relationships, law of superposition, conservation, depletion, transform, consequence, implication, alternative, convert, trade-off, economic, evolution

Teaching Standards: See [Appendix 1](#)

Synopsis: In this curriculum unit, students explore ecosystems, evolution, abiotic and biotic factors, symbiotic relationships, and the law of superposition. Students will observe their urban ecosystem and determine abiotic and biotic factors in their ecosystems, as well as track the energy flows of nutrients and resources in the ecosystem. Students will then identify sensitive and factors areas that could change the course of history of their ecosystems. Students will then explore the different methods of relative age to explain the use of fossils, ice cores, composition of sedimentary rocks, faults, and igneous rock formations found in rock layers as evidence of the history of the Earth and its changing life forms. Using this information student will also explore how current phenomenon may leave its mark on the landscape for future exploration and analysis. Students may also refer to biotechnology that could improve the future of their urban ecosystem. This unit is intended to weave together several of the eighth grade curriculum standards as a culminating or simultaneous project during student learning.

I plan to teach this unit during the spring 2019 to 125 eighth grade integrated science students.

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

Introduction

Cochrane Collegiate Academy is a 6-12 middle school and magnet high school that currently serves over 800 students. Cochrane opened in 1963 as a junior high. As the neighborhood has changed, so has Cochrane. Currently, Cochrane, is a Title I, high poverty school that's mission is "to provide five- start service to students through parent involvement and teacher support" (Cite School Improvement Plan when published). Currently the school is not a traditional model of sixth, seventh and eighth grade, due to declining enrollment and changing demographics has a sixth grade, seventh grade, seventh-eighth grade hybrid ESL, and seventh- eighth grade hybrid standard team, and 9-12. A hybrid team is defined as a team of educators that teach both seventh graders and eighth graders as opposed to one grade level as typified in the traditional middle school setting. The seventh-eighth grade hybrid ESL is taught with both eighth and seventh grade newcomers taught in the same classroom. A This overlap creates a unique situation where students and teachers must plan vertically in order to better meet the needs of students.

This curriculum is written specifically for eighth grade students but overlaps with sixth grade standards. It is based off a modified CMS pacing guide but is designed with multiple places of entry and be presented in the current order or shuffled to meet the needs of the teacher. This unit uses the North Carolina Essential Science Standards 2010 (updated 2015), which has similarities to the Next Generation Science Standards. Cochrane Collegiate Academy is a 1:1 school, but the majority of this unit can be implemented without student technology and is driven by application of science content to the students social context using place based pedagogy and the theme of time.

Rationale

Authenticity. Ownership. Access.

I am an educator. I am an educator who is intentional and honest. As I have grown in my professional practice I have often tread the line between what I believe is academic and what is personal. I often find myself asking the questions "is this professional", "will the ivory tower come down and correct me for insinuating that education is cultural and as academics we can be both professional and personal", "who's objective is objective". I teach at a Title I school with intentionality. I am lead of the science professional learning community (PLC) and tread the vertical line that connects all grade levels with purpose and fidelity. My personal identity is reflected in my students, as young person of color from low socioeconomic status. My identity is just beginning to evolve as I move up the professional ladder. Ultimately I choose to work in my current environment with passion and purpose in hopes of rectifying educational inequity and providing educational opportunity at all grade levels.

In my second year of teaching, my school district released the "Breaking the Link Report", showing that there is a correlation in poverty and poor student outcomes. The report also finally confronted the relationship between race and poverty, stating "It is this intersection of race and poverty in public schools that informs the perspective in this report" (Barnes et al 2018:7). Segregation is manifest in schools. Data in Title I schools, high poverty schools, black

and Hispanic schools, are not realizing the same data outcomes as low poverty schools with low College and Career Ready and Grade Level Proficiency scores. But in contradiction to these reports, in my opinion, there is an element in ownership that I believe has not been taken in education. My students, our students, all students are not showing proficiency in all their assessments. “We are not our test scores” has been popularized in my district and in the wake of Red4Ed I would imagine our nation. No. We are not our test scores. I am well aware of the multiplicity of identities, traumas and talents of my students. But in my experience, life is a series of tests. The ACT and SAT for college admission, PRAXIS or PEARSON for teaching, the Career Placement Assessment in the military, LSAT for law, and MCAT for medical school. Life is a series of test and scores and college and career readiness are predicated on being able to see a test as an easy overcome inconvenience and not an obstacle. Not only do we have a problem with test data but, also mindsets. The rhetoric of excellence and opportunity is unfortunately is not the experience of high poverty students.

This curriculum is created with the intent of rectifying the experience of low-income students and students of color and allow them a point of entry into the science curriculum.

School/Student Demographics

Charlotte Mecklenburg Schools (CMS) is a demographically diverse school district with approximately 156 thousand students. CMS services 37.5% African American students, 27.2% White, 25.2% Hispanic, 7% Asian and approximately 3 % other. Cochrane Collegiate Academy student population is 62.4% low-income. In addition to being a high poverty school, Cochrane is also has a significant minority population. Although a part of CMS the school’s ethnic diversity is markedly different from the profile of CMS. Cochrane Collegiate Academy is composed of 37.4% African American students, 2.8% White, 55.1% Hispanic and 3.3% Asian. With such a large Hispanic population Cochrane Collegiate Academy services near twice the number of English Language Learners as is reported as the CMS enrollment at 20.2% (Cite Navigator Accessed 09/17).

The school has been a traditional program, junior high, full magnet and is now currently a partial magnet. The middle school is traditional, and the high school is a blended learning magnet. Despite hosting a separate magnet program, North Carolina Department of Instruction calculates the data cumulatively. And despite hosting a magnet program student data is poor. In the most recent NC Report Card our school went from a D to an F school (Citation). North Carolina Accountability calculates our rating weighting proficiency 80% and growth 20%. Proficiency is the number of 3, 4, and 5’s per eligible students. In the 2017-2018 school year EOG/EOC Composite our Grade Level Proficiency (GLP) decreased from 34.3% to 30.4% a 3.9% difference. In relation to growth, Education Value-Added Assessment System (EVASS) data is not released until October 15 2018. What is released is whether a school, met, did not meet, or exceeded growth. Cochrane Collegiate Academy did not meet growth (Cite Charlotte Observer).

This data however does not tell the story of science at Cochrane Collegiate Academy. In my first two years teaching, I taught seventh grade science. My preceding science teacher in the 2015-2016 school year achieved 84% passing. In my first-year 2016-2017, percent passing was 94% and in the second academic year 2017-2018 I achieved 98% passing. These numbers include EL's and EC students. These numbers represent all students that I taught. The seventh-grade cohort I taught in achieved 54%.

Unit Goals

The goal of this unit is to provide a point of entry that allows students to engage with their social context to Engage, Explore, Explain, Elaborate, and Evaluate urban ecosystems, energy flows and earth's history across the disciplines of life sciences, physical sciences and earth sciences. Thematically the unit uses themes drawn from the Charlotte Teachers' Institute "It's about time" to discuss and investigate the sensitivity of their social context to time, and the importance and inevitability of change.

In this unit I will be addressing the following North Carolina Essential Science Standards 2010 (Updated 2015):

8.L.3 Understand how organisms interact with and respond to the biotic and abiotic components of their environment

8.E.2 Understand the history of Earth and its life forms based on evidence of change recorded in fossil records and landforms.

Background

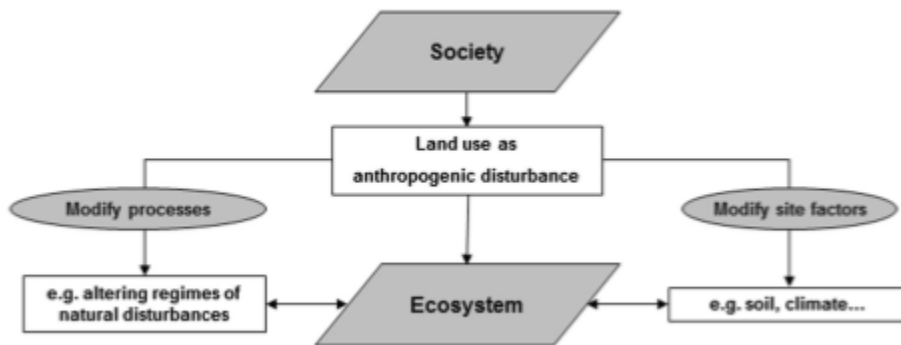
Time is a subject that varies greatly based on the discipline that defies to confront and examine it. In this curriculum unit time will be looked at through the ecological lens. Students will study and grapple with the concept of inertia, elasticity, resilience and thresholds. In Westman's "Measuring the Inertia and Resilience of Ecosystems", Westman identifies several other factors but the stood out as the most culturally relevant ones. He defines the characteristics of inertia and resilience as follows:

In ecosystems, inertia refers to the resistance to disturbance of an object or system, whereas the remaining four terms are properties of resilience, which refer to ways in which the disturbed system responds. Elasticity refers to the time involved in restoration; amplitude to the degree of brittleness of the system; hysteresis to the degree to which the pattern of recovery is not simply a reversal of the pattern of initial alteration; and malleability to the ease with which the system can be come permanently altered. (Westman 2012: 705)

In my school many of my students are subject childhood traumas also known as adverse childhood experiences (ACE). Children that are subject to ACE are more likely to experience negative outcomes in school. ACE is correlated resilience. "Practitioner Review: Diagnosing

childhood resilience – a systemic approach to the diagnosis of adaptation in adverse social and physical ecologies” says “resilience is predicted by both the capacity of individuals, and the capacity of their social and physical ecologies to facilitate their coping in culturally meaningful ways” (Ungar 1978:4). There is an intersectionality in both ideas that make the concept of ecosystems a place to create meaningful conversation about both how time and environment, social and physical factors can determine success. There is variable nature in both natural ecosystems and what I will discuss with my students as urban ecosystems.

Urban ecosystems are treated as separate from humans. In “Urban Landscapes and Sustainable Cities” Andersson writes “Cities are subjected to a strong human influence, and management decisions have profound implications for ecosystem function. One of the central tenets in landscape ecology is that processes can be inferred from geographical patterns, but it may not be that straightforward in urban landscapes where human activities both transcend habitat boundaries and differ between patches of the same habitat” (Andersson 2006:1). Humans are also animals and a part of ecosystems and I want my students to tease out what it is and not just view ecosystems in isolation. In the image below taken from “Legacy Effects of Human Land Use: Ecosystems as Time-Lagged Systems” the presence of society and its relationship becomes apparent (Burgi et al. 2017: Fig 1) .



I would suggest a line and not a ray to connect all elements of the diagram.

So what does the intersectionality of humans and ecosystems have to do with resilience and time? In order for ecosystems to survive the best of course of action is typically according to research to leave them alone. It is only in situations of human intervention that you see the decay of ecosystems. In the CTI Seminar discussion of “And Wild For to Hold”, the idea came up that when you mess with times like the captors of Anne Boleyn in Nancy Kress’ science fiction “what is it exactly are you trying to save” (Figure out how to cite seminars). Instead of educating students about the sensitivities of ecosystems to human ecosystems for the benefit of “the environment” a more student-centered lesson might capitalize on the overall message. In the middle school context asking the question “what is it exactly are you trying to save”, speaks to urgency and refocuses the perspective of the questions on student impact.

Once it has been established that humans have their own ecosystem that is fairly resilient to change human impact is one of the biggest drivers, students will begin to look at the legacies. In Legacy Effects of Human Land Use: Ecosystems as Time-Lagged Systems” it says “Past land

use may persist as memories or legacies for a very long time in ecosystems and may, for example, influence biodiversity and ecosystem productivity (Perring and others 2016). Also very subtle but long-term human impact may have long-term effects on soil and vegetation, and remain detectable centuries later” (Burgi et. al 2017:96). Additional questions arise from this statement in which I want my students to explore: How do you know time is passing? How do you know there is a past? How do you know what happened in the past?

In “Is the age of the earth one of our ‘sorest troubles?’” perceptions about deep time affect students’ acceptance of evolutionary theory” the authors describe how essentially the limited scope of time reference that students have impact their susceptibility to influence when suggested that evolution is a myth. This phenomenon impacts students beyond evolution. Based off this research inability of students to reference a larger body of time. This could span from literature, to mathematical concepts such as the repeating decimal. Essentially students have a finite frame of time in which they can reference. As they age and that frame expands, they are better able to imagine what may be beyond the frame and think more abstractly. It is this phenomenon which negativity impacts their ability to think of the earth’s age and the impact of time in the creation and evolution of ecosystems.

The importance of perspective is parallel to the CTI “It’s About Time” Seminar on Edwin Abbott’s “Flatlands: A Romance of Many Dimension” and how based off the reference point certain elements of the dimension were not apparent (figure out how to cite seminar). In the first part of the novella the square tells us of his universe, which he likes to a flat piece of paper and his being like a penny viewed on its side where “Nothing was visible, nor could be visible, to us”, (Abbotts 1884:2) and says “On the contrary, we could see nothing of the kind, not at least so as to distinguish one figure from another. Nothing was visible, nor could be visible, to us, except Straight Lines” (Abbotts 1884:2). By the end of the novel after being shown the world in three dimensions in Spaceland by the sphere the square can change his perspective of reality, even to consider a fourth dimension. Conceiving of time is much like that for students. Their point of reference is by comparison significantly smaller and thus expanding their perception of time can be like trying to see a third dimension when all you have ever seen is the second. The scope of time seems inherent, can they not conceive of time by looking at parents or grandparents. Or maybe the grand Canyon. But “Is the age of the earth one of our ‘sorest troubles?’ Students’ perceptions about deep time affect their acceptance of evolutionary theory” admits deep time is difficult for everyone.

Deep time is conceptually difficult for the general public, science educators, and students throughout the educational spectrum to grasp. Charles Darwin himself had a hard time grasping “deep time”—the geologic concept of time, requiring billions of years— but knew that it was essential for his proposed evolutionary mechanism. Darwin didn’t publish any estimates of Earth’s age, but in the first edition of On the Origin of Species he did estimate the time needed to erode the Weald (a region in south England stretching from Kent to Surrey), “say three hundred million years.” He then explained: “I have made these few remarks because it is highly important for us to gain some notion, however, imperfect, of the lapse of years. (Cotner et al. 2010:861)

At this point of time, the point of reference is the earth’s strata, which even still has not been excavated as deep as the Kola Superdeep Borehole . Students will be asked to imagine

future strata. Zalasiewicz in *The Earth after us: what legacy will humans leave in the rocks?* imagines the earth 100 million years in the future and what the aliens would find. In what she and other ecologist and geologist all the Anthropocene “Our remains will not tun up Dr. Who-style, brittle and shrouded with cobwebs, they will need to be uncovered with persistence, by following a trail of clues- red herrings. It will be vital for geological explorers to work out the geographical for this planet, for some part of will have become geology (Zalasiewicz). The challenge then becomes what survive. In It’s About Time CTI Seminar Professor Matt DeForrest said “ The imagination is a form of time travel” (DeForrest 2018) , in this unit the attempt is to uncover the history of Earth by having students situate themselves in the past.

Pedagogy

The basis for this unit is grounded in the BSCS Science 5Es instructional model developed in 1957, Biological Sciences Curriculum Study (BSCS) was the original name but it has sense been renamed to simply BSCS Science. BSCS Science Learning is an independent nonprofit organization that focuses on the development of science curriculum. The 5E’s are Engage, Explore, Explain, Elaborate, and Evaluate. Specifically developed for science this instructional model creates a point of entry for students and allows them to develop their content knowledge by scaffolding the curriculum. In order to engage students

“Teaching as Science for Social Justice” by Angela Calabrese Barton also informs this unit. Barton is a masterful advocate who has found the place where science connects to social justice. Science in her book is a responsive subject for students in urban poverty because everyone is always doing science. Science is innovation and breaking the world down and reassembling it to make sense. The as science educators we must rethink what we define as scientific and consider what our students see as scientific. That cultivating “scientific thought” is can be just as important as teaching “science” (2003:12). Her book recounts the tales and experiences as she teaches science in after school programs and in the classroom. It is from her that I derive the strategy “activating science knowledge” (2003: 9). Math is often heralded as the universal language, science is simply universal.

The bulk of this curriculum unit is informed by the use of place-based pedagogy or place-based education. “In many ways PBE has become a rallying point for school reformers in neoliberal times. It offers a progressive alternative to the high school curriculum that is particularly alienating for many students. It challenges the authenticity of mandated curriculum and authorises locally produced knowledge” (McInerney et. al 2015:). Students should learn in relation to and not in isolation of their communities. Especially in my context of a high poverty and majority African American school the content is not always reflective of their own experiences and cultural identities. Place based pedagogies tries to keep learning local. Some of the critiques of place-based education are: “prevailing assumptions about the notions of place, identity and difference; the pedagogical limitations of place-based curriculum; the limits to local activism when it comes to transforming communities” (McInerney et. al 2015:) . These criticisms McInerney in ““Coming to a place near you?” The politics and possibilities of a critical pedagogy of place-based education” refute saying, we see this as a ‘pedagogy of responsibility’ (Reid, 2007) that is grounded in a commitment to environmental sustainability and social justice. Although teachers are constrained by mandated curriculum requirements, there is still scope for

place-based learning in the selection of subject content and pedagogies” (McInerney et. al 2015:).

Instructional Implementation

Instructional Strategies

- **Accountable talk:** Accountable talks a method of teaching students to use academic language in conversations often with the use of sentence stems to make them accountable for their contributions and the contributions of other.
- **Adapting to learning styles/multiple intelligences:** Although this unit is heavy with visuals, students frequently talk, write and move during the course of the unit.
- **Mastery learning:** Students are evaluated based on their ability to assemble information and is scaffolded so that you can identify student needs at each section. Teachers could facilitate this unit in a staggered fashion.
- **Analysis of student work:** Students will use exemplars and each other’s work to spark conversations and determine high caliber products.
- **Cooperative learning:** In the beginning stages of the unit students will use each other and their ideas to formulate definitions and understanding of key concepts.
- **Notebooking/journaling:** During the explore section students will engage in a notebook activity. Also, in the Evaluate section there is a photo journal component.
- **Design:** Students will create visual representations of their learning at various points throughout the lesson all culminating in a Tumblr project.
- **Discovery/Inquiry-based learning:** Students will use nontraditional visual resources to access science content.
- **Field study:** Students will explore their neighborhoods and take photos to create a photo assemblage of their ecosystem to interpreted and analyzed in the classroom.
- **Graphic organizers:** Students will be asked to map out their thinking through guiding questions as opposed to structures brainstorming activities.
- **Structured social controversy:** Due to the social context of my population students will be asked to identify factors in their community along lines of race and poverty to prompt conversations about our environmental futures and uncovering environmental injustices.
- **Identifying similarities and differences**
- **Targeted feedback**

In the first day of content the objective of the day is “Students will be able to define abiotic and biotic factors”. The teacher should not give the students a clear definition of either term. Students will work towards a collaborative definition. The following lessons are scaffolded so that students build on their learning. The expectation of the teacher should not be to create experts in a day. Throughout the unit the teacher’s role is to facilitate the learning of students and allow them to carry the load. With regards to time, although the unit is broken down in five sections the overall lessons may take longer than five days. Extend could take between one and two class periods. The final section evaluate could take anywhere from 2- 4 class periods depending on students. Allow students sufficient time to move through the unit and the teacher may want to supplement to facilitate a better flow in the classroom. In my own classroom I facilitate warm up and daily assessments on previous content for the purpose of classroom management, Another

recommendation for this unit is that before teachers assemble the necessary materials for this unit, teachers should reflect on what is relevant to their student population as they consider the cultural context of their resources.

Engage

According to the 5E model engage should be viewed like a hook. Visual literacy is essential to this unit and is an equitable point of entry into the curriculum unit. Students in this unit are being trained to see time. The Learning Network uses *New York Times* images and publishes “What’s going on in this Picture” every Monday. More information is revealed about the photo on Thursdays. Students also can engage with the picture in the comments below. Teachers can use this tool for day one and as a weekly warm up throughout the unit in order to engage students. This tool can be used to mirror the Law of Superposition later in the unit. Students can track the conversations from the bottom post, to the most recent post at the top, and discuss how the meaning of the picture evolves over time from the bottom up.

On the original date when the teacher presents the image, The Learning Network recommends the three following questions:

- What is going on in this picture?
- What do you see that makes you say that?
- What more can you find?

For the first few iterations of this activity it is recommended to use the same line of questioning in order to normalize what students should look for and how they should talk about what they see. Once students have analyzed what they see the teacher should add: Is this picture still happening? Does this picture capture what’s going on at that point in time? Why or Why not? Is there anything in the photo that is living? How do you know?

Explore

Teachers should assemble a collection of images that feature both biotic and abiotic factors. In my current school context, I pull images from field trips and their Healthy Active Children Intervention Time, the equivalent of recess, and walk the neighborhood taking photos. Photos should not be taken on the same day and should look familiar. Mix those photos in with photos from popular culture. Students will be asked to independently identify biotic and abiotic factors. Students will then be asked to pair share and add, subtract or change their identifications and justify their additions, amendments, and corrections to their partners. Lastly, the teacher will share out what they identified. Students should be invited to disagree with their teacher. In order to differentiate students with low oration skills should be provided with Accountable Talk Sentence starters such as “I disagree with _____, because _____”. I have found having students keeping their accountable talks stems on a bookmark in their notebook aids in facilitating quality conversations (See Appendix 2).

Explain

Students should bring to class a picture of when they were younger and take a current picture. Students should be instructed to bring a candid shot instead of a portrait. Teacher will need to define the difference the day prior when informing the students to bring the photos in. A simple way to describe the difference is to ask students to strike a pose. Take photos of the students striking poses and tell students that a candid photo is the opposite.

Teachers should anticipate some students may be unable to bring in baby pictures. Students should not be punished, and teacher should present alternative option. Teachers should have alternative photos sets on hand; celebrity photos are an alternative and teacher should be cognizant of their cultural relevance. Students should be asked to make a describe the first photo. Using the same questions from the “What’s going on in this picture” students should analyze the photo.

Students should be encouraged to share out. Teacher should explain that you only have lived a short amount of time in comparison to age of earth. Teacher should prompt students to think about how they might have changed if they lived for hundreds, thousands or billions of years. Inform students that some species have lived on earth for thousands of years and we can study changes in their anatomy and DNA.

Students will then be shown evolutionary photos through history that depict an evolutionary change over time. Ideally these animals and or plants will come from the same ecosystem. For example, students can be shown the evolutionary trajectory of animals within the same arctic region. For this exercise students should work in groups of 4-5. Teacher should place the pictures in a plastic sleeve and be given wet erase markers. As the teacher is scaffolding their level of instruction students will utilize the I² Strategy to identify and interpret the images. In groups students should be asked to circle and discuss traits that appeared, and students will then be placed in groups with the ecosystems.

Step 1: Identify (“What I see” comments)

Identify any changes, trends, or differences you see in the graph or figure.

Draw arrows and write a “What I see” comment for each arrow.

Be concise in your comments. These should be just what you can observe. Do not try to explain the meaning at this point. (BSCS 2012)

Step 2: Interpret (“What it means” comments)

Interpret the meaning of each “What I see” comment by writing a “What it means” comment

Do not try to interpret the whole graph or figure. (BSCS 2012)

Step 3: Caption

Write a caption for the graph or figure.

Start with a topic sentence that describes what the graph or figure shows.

Then join each “What I see” comment with its “What it means” comment to make a sentence.

Build a coherent paragraph out of your sentences. (BSCS 2012)

To help students facilitate the discussion the teacher can do a mock discussion to create an exemplar with the students. The exemplar can be like the assignment or can be completed with any graph or figure.

As a follow, up to the construction of the I² caption students can be asked, do you think that any of the organism had a relationship, and if so what was the nature of their relationship, was it symbiotic and if so was it mutualism, commensalism, or parasitism. In my classroom we utilize the input/output method for notebooks. Students should open their notebook to the next two clean pages. For input on the left page, allow students to look up definitions and have them make a key in their notebook. The title should be “Symbiotic Relationships Key”. They should write the word, define it, the draw a picture or emoji to represent the relationship. For their output on the right page, ask them to make a table in their notebook that looks like the following

Animal	Possible Relationships	How do I know?	How could their relationship have changed over time?

Extend

It is in extend that students will begin to engage with scientific text to become experts on aging techniques. This is an open-ended project that ask students to learn and engage by constructing their own knowledge of ecosystems and aging. Students should make a “Earth Aging Techniques” board using the Board Builder feature on Discovery Education. If your school does not have a subscription to Discovery Education (DE) then a PowerPoint is your best substitute. Students should be asked to include fossils, ice cores, composition of sedimentary rocks, faults, igneous rock formations, and the earth’s strata/law of superposition. According to the DE website “Board Builder allows students to merge their own research, writing, and content creation”. Students use a multiplicity of media to almost create their own 5E modeled boards on topics. This may seem rather open ended, but DE provides exemplars of student boards that can be provided to students to create their own work. Exemplars instead of rubrics in this context forces students to deconstruct quality work and reconstruct it as their own within their new confines of the topic.

Evaluate

This section functions as your assessment of knowledge for this unit. Students will be asked to photograph their communities to document their ecosystem and capture a moment in time. They will then define their ecosystems abiotic and biotic factors. Students should then be prompted are their any “invisible” factors that influence their ecosystems. Invisible factors are defined as factors outside the scope of the camera that influence how their ecosystems respond to stress. This is where you bring in society and anthropogenic intervention.

Students should create a word wall and invited to write factors. When facilitating word walls, I implement a strategy I made up called play, pause, rewind and fast forward. When the teacher says play students may walk talk or write, but if a student writes something the teacher would like to look at closer, the teacher says pause. The class should stop moving after pause, and the teacher can say one of two phrases:

Rewind= Explain your thinking

Fast forward= Let's discuss this topic.

When the teacher says play classroom activities proceed as usual. The purpose of this part of the lesson it to intentionally point out environmental injustices and anomalies. . For example, in my own community the Boys and Girls club is beside a power station. Teachers should prepared and knowledgeable about stressors in their ecosystems

After discussing the “invisible factors it is time to get into the body of the project. Prior to using the images students should share photos similar to the way the Engage activity was facilitated. This will hopefully help frame the project for students so that the understand the reason behind their photos. The project should then be introduced as follows.

Teacher Says: “We have become experts on reading images as a moment in time, comparing images to see changes over time, and today we will begin blending that knowledge to formulate a picture of our future. If we continued to live in our current ecosystem, your current ecosystem your neighborhood, what would survive? What would the future look like? What hints would it give to our past? How will we end up in our future?”

There are a number of factors if you look deeply at your ecosystem that hint toward the future. You will be creating a Tumblr page to recount how your ecosystem will be stressed to its end. I have provided you with a rubric with some things I want you to think about and add to your tumblr. Although, not a picture of the future <http://bornafterfreedom.tumblr.com/> is a page that immortalizes Enoch Donaldson and African American Worker at Davidson College. Notice how the author decided to uses different media sources to tell his story. I want you to think about how you tell your story or your current ecosystem and its future.

To recap, the first thing you should do is a close read of your ecosystems and identify abiotic, biotic and invisible factor that make it up. Describe your ecosystem and its context and how do you fit it. Secondly use that information to determine how most likely your ecosystem will change beyond your life time. Third, determine what artifacts would survive and would earth dating techniques could we use and what would they tell us. Also, ask your self what lifeforms and landforms would survive and how would they change or evolve. Finally put together all this information.”

Formulate a checklist with the guiding questions as students brainstorm their ideas before creating their own Tumblr pages. Students should be provided with rubrics prior to beginning projects so that they can self-evaluate throughout the duration of the project.

Appendix 1

Evolution and Genetic Variation

Objective	Essential Question(s)	KNOW	Key Words
<p>8L4.1 Summarize the use of evidence drawn from geology, fossils, and comparative anatomy to form the basis for biological classification systems and the theory of evolution.</p>	<ol style="list-style-type: none"> 1. How can changes in environmental conditions affect the survival of individual organisms and species of life on Earth? 2. How have climate, geography and sea level changes affected the evolution of life on Earth? 	<p>Scholars know that biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a environment.</p> <p>Scholars know that most species that have lived on the earth are now extinct. Extinction of species occurs when the environment changes and the individual organisms of that species do not have the traits necessary to survive and reproduce in the changed environment.</p> <p>Scholars know that living things evolve in response to changes in their environment.</p>	<ul style="list-style-type: none"> • Evolution • Theory of Evolution • Plate Tectonics Theory • Law of Superposition • Adaptation • Theory of Evolution • Extinction • Biological Classification • Taxonomy • Strata • Physiology

<p>8L4.2 Explain the relationship between genetic variation and an organism's ability to adapt to its environment.</p>	<ol style="list-style-type: none"> 1. Explain how genetic diversity affects the likelihood that a species will be able to adapt to environmental changes. 2. How do environmental, behavioral and genetic factors affect a species chance of survival? 3. How does natural selection play a role in evolution? 	<p>Individual organisms with certain traits are more likely than others to survive and have offspring.</p> <p>Changes in environmental conditions can affect the survival of individual organisms and entire species.</p> <p>Explain the relationship between genetic variation and an organism's ability to adapt to its environment.</p> <p>Living organisms have morphological, biochemical, and behavioral features that make them well adapted for life in the environments in which they are usually found.</p>	<ul style="list-style-type: none"> • Inherited Traits • Phenotype • Diversity
--	---	---	--

Rock Cycle & Geologic Time Scale

Objective	Essential Question(s)	KNOW	Key Words
<p>8E2.2 Explain the use of fossils, ice cores, the composition of sedimentary rocks, faults, and igneous rock formations found in rock layers as evidence of the history of the Earth and its changing life forms.</p>	<p>How do ice cores tell scientists how the earth has changed? Atmospherically? Through lifeforms?</p> <p>How has the shifting of faults changed the Earth's landforms and lifeforms?</p> <p>How do index fossils help determine the relative age of Earth?</p>	<p>A variety of artifacts are used to determine the geological history of the Earth</p> <p>A variety of artifacts can determine how life forms have changed over time.</p> <p>A variety of artifacts can determine how the atmosphere has changed over time</p> <p>A fault is a break in the rocks that make up the Earth's crust that is formed due to the movement of rock on either side of the fault.</p>	<ul style="list-style-type: none"> • Ice core • Sedimentary rocks • Faults • Igneous rocks • Intrusions
<p>8E2.1 Infer the age of Earth and relative age of rocks and fossils from index fossils and ordering of rock layers (relative dating and radioactive dating).</p>	<p>How do fossils provide evidence of how life and environmental conditions have changed?</p> <p>What are fossils? How are they formed? How do they provide a historical record of the earth?</p> <p>How does the location and species of an index fossil help determine the age of rocks around it?</p>	<p>Fossils provide important evidence of how life and environmental conditions have changed.</p> <p>A fossil is the preserved remains or traces of an organism that lived in the past.</p> <p>The formation process of mold, cast, petrified, preserved, carbonized, and trace fossils.</p>	<ul style="list-style-type: none"> • Fossils • Mold fossils • Trace fossils • Cast fossils • Petrified wood • Preserved remains • Geologic Time Scale • Relative Age • Law of Superposition • Absolute Age • Radiometric Dating • Precambrian Era

	<p>How does the age of a rock at the bottom of a rock formation compare to that of a rock at the top of a rock formation?</p> <p>How can the amount of parent material in a rock sample be determined by using half-lives?</p> <p>How does the amount of parent material in a sample change as time increases?</p>	<p>The geologic time scale is a record of the major events and diversity of life forms present in Earth's history.</p> <p>The relative age means the age of one object compared to the age of another object.</p> <p>That geologists use radiometric dating to estimate how long-ago rocks formed, and to infer the ages of fossils contained within those rocks.</p>	<ul style="list-style-type: none"> • Paleozoic Era • Mesozoic Era • Cenozoic Era
--	--	---	---

Appendix 2

Accountable Language Stems

Agreement

- “I agree with _____ because _____.”
- “I like what _____ said because _____.”
- “I agree with _____; but on the other hand, _____.”

Disagreement

- “I disagree with _____ because _____.”
- “I’m not sure I agree with what _____ said because _____.”
- “I can see that _____; however, I disagree with (or can’t see) _____.”

Clarifications

- “Could you please repeat that for me?”
- Paraphrase what you heard and ask, “Could you explain a bit more, please?”
- “I’m not sure I understood you when you said _____. Could you say more about that?”
- “What’s your evidence?”
- “How does that support our work/mission at _____?”

Confirmation

- “I think _____.”
- “I believe _____.”

Confusion

- “I don’t understand _____.”
- “I am confused about _____.”

Extension

- “I was thinking about what _____ said, and I was wondering what if _____.”
- “This makes me think _____.”
- “I want to know more about _____.”
- “Now I am wondering _____.”
- “Can you tell me more about _____?”

Review

- “I want to go back to what _____ said.”

Appendix 3

Project Rubric

	4	3	2	1
Context: Ecosystems	<ul style="list-style-type: none"> • Describes their community in detail • Identifies and explains nvisible factors • Talks about themselves and their relationship with the community. • Creates a good sense of space and place • Provides multiple forms of media (Photographs, Video, maps, Pictures, drawings) 	<ul style="list-style-type: none"> • Provides a general sense of their community but could be any town. • Identifies invisible factors. • Mentions living there. • Has a sense of the space. • Provides one or two media sources 	<ul style="list-style-type: none"> • Brief non-detailed description of the community. • Same type of media. 	<ul style="list-style-type: none"> • Does not frame their project.
Context: Evolution/ Earth Aging	<ul style="list-style-type: none"> • Describes how most likely their ecosystem will undergo stress or be destroyed and justifies their answer. 	<ul style="list-style-type: none"> • Describes how their ecosystem will undergo stress or be destroyed and justifies their answer. 	<ul style="list-style-type: none"> • Describes general destruction. 	<ul style="list-style-type: none"> • Does not mention clearly
Content: Ecosystems	<ul style="list-style-type: none"> • Identifies 10 or more Abiotic and Biotic Factors. • Explains and defines the Symbiotic Relationship • Gives examples of symbiotic relationships between organisms in the community and 	<ul style="list-style-type: none"> • Identifies 9- 7 Abiotic and Biotic Factors. • Explains and defines the Symbiotic Relationship • Gives examples of symbiotic relation between organisms in the community and determines which 	<ul style="list-style-type: none"> • Identifies 6- 4 Abiotic and Biotic Factors. • Explains and defines the Symbiotic Relationship between organisms • Discusses how the ecosystem was formed over time 	<ul style="list-style-type: none"> • Identifies less than 4 Abiotic and Biotic Factors. • Defines the Symbiotic Relationship between organisms • Discusses how the ecosystem was formed over time

	<p>determines which relationship explicitly with supporting evidence</p> <ul style="list-style-type: none"> • Discusses their urban how the ecosystem was formed over time • Provides creative, detailed, and aligned images of their community 	<p>relationship implicitly with supporting evidence</p> <ul style="list-style-type: none"> • Discusses how the ecosystem was formed over time • Provides detailed and aligned images of their community 	<ul style="list-style-type: none"> • Provides and aligned images of their community 	<ul style="list-style-type: none"> • Provides and aligned images of their community
<p>Content: Evolution/ Earth Aging</p>	<ul style="list-style-type: none"> • Describe 4 ways their ecosystems age could be determined and defines each. • Describes 5 or more artifacts that would survive and the stories they would tell • Describes how the earths landforms and life would evolve • Cites specific evidence and traits of that evolution. • Provides photos that are scientific, descriptive and support their narrative 	<ul style="list-style-type: none"> • Describe 3 ways their ecosystems age could be determined and defines 1-2 • Describes 4 - 3 artifacts that would survive and the stories they would tell • Describes how the earths landforms and life would evolve • Cites specific traits evidence of that evolution. • Provides photos that are descriptive but don't necessarily align with the narrative 	<ul style="list-style-type: none"> • Describe 2 ways their ecosystems age could be determined • Describes 2 artifacts that would survive and the stories they would tell • Describes how the earths landforms and life would evolve • Cites evidence of that evolution. • Provides photos that scientific. 	<ul style="list-style-type: none"> • Describe 1 ways their ecosystems age could be determined • Describes 2 artifacts that would survive and the stories they would tell • Describes how the earths landforms and life would evolve • Does not cite evidence of evolution • Photos unrelated

TOTAL: ___/16

Bibliography

- Abbott, Edwin Abbott, Valerie M. Smith, and John Allen Paulos. 2013. *Flatland: a romance of many dimensions*.
A narrative book about perspective and how we cannot see beyond our own content unless shown by someone who has a greater perspective through their own.
- "Accountable Language Stems." *Education Closet*. Accessed November 5, 2018.
<https://educationcloset.com/wp-content/uploads/2015/09/AccountableTalk-Stems.pdf>.
A resource that has a list of accountable language stems to facilitate academic discourse in the classroom. It also has goals and objectives of accountable language stems in different contexts.
- Andersson, Erik. 2006. "Urban Landscapes and Sustainable Cities". *Ecology and Society*. 11 (1): 34.
An article on how urban landscapes can be considered their own ecosystems. This article highlights that humans must not see themselves as outside of their ecosystems but as a part of it. It focuses on the relationship between humans and maintain their ecosystems through sustainability.
- Barnes, Frank. *Breaking the Link Report.* Charlotte Mecklenburg School Office of Accountability, Charlotte, 2018.
A report on equity in education released by Charlotte Mecklenburg Schools. The report links educational outcomes of high poverty students to three educational levers, great teaching, access to college level course and access to time.
- Bürigi, Matthias, Lars Östlund, and David J. Mladenoff. 2017. "Legacy Effects of Human Land Use: Ecosystems as Time-Lagged Systems". *Ecosystems*. 20 (1): 94-103.
An article describing the how ecosystems are sensitive to time and the impact of humans on the life of an ecosystems. Ecosystems have their own natural clock that allows them to survive and survive even with human interventions. The article details the effects of humans that have been the most impactful.
- Calabrese Barton, Angela. 2003. *Teaching Science for Social Justice*. The Teaching for Social Justice Series. New York: Teachers College Press.
A book about using children's natural ability to do science and refocus it for self reflection and ultimately action. It begins by identifying what is science in high poverty communities and leading children through inquiry practices to discover questions and problems and implement projects for the advancement of their communities. Also this book focuses on access to science education.

Cotner, Sehoya, Brooks, D. Christopher, and Moore, Randy. "Is the age of the earth on of our 'sorest troubles? Students' perceptions about deep time affect their acceptance of evolutionary theory." *Evolution* 64, no. 3 (March 2010): 858–864.

This article speaks to how students experience time and thus how they construct time in their heads. It helps the reader understand that the rejection of change over time is due to how culture forms them to accept and understand deep time. That deep time is a concept that if introduced earlier allows students to engage in the science of evolution.

DeForrest, Matt. "It's About Time." Speech, NC, Charlotte, November 1, 2018.

A seminar lecture in which seminar participants studied "The Time Machine" and discussed the question, what does a time travel story allow a storyteller to do, relative to contemporary culture?

"I Can Use the Identify and Interpret (I2) Strategy". BSCS. 2012. elearn.bscs.org.

This resource is from the BSCS the founders of the 5E instructional model. This resource scaffolds visual literacy for students that forces them to engage with graphs, images and models to formulate captions and conclusions.

Mayes, Kimberly. "Enoch Donaldson: Born after Freedom." Enoch Donaldson. December 09, 2015. Accessed November 18, 2018. <http://bornafterfreedom.tumblr.com/>.

This is a tumblr page that was curated in college to create a digital life after death. It features varying multimedia sources to reconstruct the life of a janitorial worker at Davidson College. In this paper it is used as an exemplar of how media can be curated to convey a message.

McInerney, Peter, John Smyth and Barry Down. 2011. "“Coming to a place near you?’ The politics and possibilities of a critical pedagogy of place-based education," *Asia-Pacific Journal of Teacher Education*, 39:1, 3-16.

Pedagogical research on the importance of place based education. Describes effective ways to utilize place based pedagogy regardless of the standards. They give examples for the classroom and outline ways that it has been used. The article reports evidence of place based pedagogy improving outcomes.

"Student Center Resources." Discovery Education. Accessed November 18, 2018.

<http://www.discoveryeducation.com/StudentCenterResources/>.

A description of Boardbuilder a tool created by and distributed by Discovery Education. It provides a step by step tutorial of how to effectively use and implement board builder in the classroom. In addition the webpage provides 50 ways that board builder can be used, exemplars and webinars.

Ungar, Michael. 2015. "Practitioner Review: Diagnosing childhood resilience - a systemic approach to the diagnosis of adaptation in adverse social and physical ecologies". *Journal of Child Psychology and Psychiatry*. 56 (1): 4-17.

An article about how children perceive their environments, experience their ecologies and adapt to their surroundings. The article primarily focuses on children that have experienced adverse childhood experiences. It is useful research in determining how to help students unpack their ecosystems and imagine beyond their experiences.

Westman, Walter E. 1978. "Measuring the Inertia and Resilience of Ecosystems". *BioScience*. 28 (11): 705-710.

This article describes the concepts of inertia and resilience with regards to ecosystems. It details ecosystems can fail and flourish based off of key factors. Essentially ecosystems have a fluid lifespan and its survival can be measured by looking at key points in time.

Zalasiewicz, J. A., and Kim Freedman. 2008. *The Earth after us: what legacy will humans leave in the rocks?* Oxford, UK: Oxford University Press. <http://site.ebrary.com/id/10278913>.

A book written in the narrative style that describes what aliens would find if they visited the Earth. The different evidences they describe are accompanied by information that could be derived from the artifacts.