

# Translating Climate Education: Primary Climate Change Education for Spanish- heritage speakers in Out-of-School Experiences

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A project submitted in partial fulfillment of the requirements for the degree of Master of  
Science (Environment & Sustainability) at the University of Michigan -- December 2018  
December 18, 2018

## **Abstract**

Climate change education is becoming a prominent topic covered in K-12. However, studies have shown that misconceptions about climate change are pervasive within secondary students (Shepardson et al., 2011; Lambert et.al, 2012). Additionally, curricula are typically developed without consideration for the sociocultural context within which it is enacted. Therefore, it is important to understand what a climate change curriculum might look like at the primary level to might better assist student learning and understanding of climate change at the secondary level. Using a socio-constructivist approach to learning, a 6-week unit on climate change for a fourth grade class was developed in partnership with an Ann Arbor-based Spanish literacy program. The unit consisted of 5 lesson plans and an evaluation. After course implementation and reflection at the end of the year on learning outcomes, the lesson plans were updated with three additional lessons included all translated in English along with a list of recommendations.

### **Acknowledgements**

I would like to thank the program, En Nuestra Lengua, the program director, Teresa Satterfield, and the students and families of En Nuestra Lengua for allowing me the opportunity to work with them to develop educational materials on climate change. I would like to thank you, Dr. Sara Adlerstein Gonzalez for her support in advising me throughout the practicum experience.

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## **Introduction**

With an increasing push to include climate change education into the school curriculum, schools across the United States have begun to move towards developing the knowledge base, skills, and experiences that support student learning around climate change concepts (Next Generation Science Standards Lead States, 2013). Given the complex nature of climate change, students typically learn about climate change in middle school or high school, with elementary school years dedicated to building the foundation that will allow them to understand climate change (Next Generation Science Standards Lead States, 2013). However, a pervasive issue in supporting student learning around climate change has been misconceptions held by students and instructors alike. Indicating that the introduction of fundamental knowledge and practice of skills should begin earlier than secondary school.

Additionally, although studies on curriculum design have investigated alternative forms to the traditional factory model of teaching, little research has looked at the use of curriculum that considers and responds to the sociocultural context in which the curriculum is enacted. It is widely known that the U.S. communities that will be most affected by the impacts of human-induced climate change impacts will be low-income and communities of color (Lynn, 2011; McGeehin, 2001; Wilson et al, 2010). To support the future generation of climate-informed citizens, it is necessary to have climate change curriculum that is developed with the unique characteristics of these communities in mind.

## **Literature Review**

### *Out-of-Classroom Factors*

As will be highlighted below, learning about climate change can be difficult, however, there are out-of-classroom factors that further complicate access to climate change education. Although this will not be the center of this literature review, it is important to recognize the socio-political factors outside of the classroom environment that present barriers to climate change education.

Within the U.S., climate change has become a highly polarizing political topic. Since the 1980's when climate change became a part of the U.S. national agenda under the Reagan administration, climate change has become a topic subject to the bipartisan division (Hoffman, 2018). There are multiple studies that have explored this trend (Fortner, 2006; McCright & Dunlap, 2000; Lutzenhiser 2001). For example, an investigation carried out by researchers analyzed a decade's worth of data from opinions polls and found that an individual's political membership generally lined up with whether they believed there was scientific consensus around climate change and if they expressed personal concern for global warming (McCright & Dunlap, 2011). Liberals and Democrats were generally in agreement with scientific consensus, whereas conservatives and Republican were not. Similarly, a different study explored the relationship between political ideology and support for renewable energy and energy efficiency, and founds something similar, wherein in political ideology was connected to whether a politician would support renewable energy and energy efficiency (Hess, 2016). It is, therefore, no surprise that efforts to implement climate change as a fixed part of school curricula are contentious.

In other cases, even when climate change education has been allowed to be taught within schools, school politics discourage its integration. For example, in that State of Texas, there was a longstanding debate around textbook representations of climate change (Bagley, 2015). Science textbooks held incorrect climate science information, and although publishers agreed to make edits to the textbook, the process of actualizing the edits was dragged out by the Board of Education members. As a mostly politically conservative member board, the textbook edits did not simply represent updates to a textbook, but also a stance on their view of climate change. The city of Portland faced similar contention but from parents when it chose to eliminate the use of textbooks that had limited or misleading climate change information (Carpenter, 2016).

Uneasiness around integrating climate change can also be seen at the level of teachers. In an ethnographic exploration of perceptions around teaching climate change amongst pre-service teachers, researchers learned that teachers were afraid to teach climate change because of the tension it might create with peer-teachers. They voiced fear of conflict over disagreements over their decision to teach climate change (Berger, 2015). Additionally, as shared by the authors, “teachers are subject to different dynamics and may be vulnerable” (Berger, 2015). Similar findings have been identified in other research (Herman et al., 2017). Without even diving into the content of climate change education, the topic is difficult to engage.

### *Student Misconceptions*

One of the greatest challenges to teaching climate change to students is dispelling the misconceptions that students hold. A number of studies that have set out to understand student conceptualizations of climate change have revealed that students of

varying age groups, hold misconceptions about climate change. The most prominent misconceptions that students hold relate to erroneous causal relationships and misidentifying climate actions.

Studies around student conceptualizations of climate change have revealed that students will often create incorrect causal relationships between different climate science concepts. For example, a survey administered by researchers to assess knowledge revealed that students linked global warming to ozone depletion (Boyes and Stanisstreet, 1993). They attributed the ‘hole’ in the ozone layer to earth’s rising temperature and believed that the ‘hole’ allowed sun rays to penetrate the earth. Similarly, in a different study where researchers held interviews with middle schoolers in order to understand their conceptualization of global warming, student responses revealed that were unable to discriminate between major contributors and contributors to global warming (Rye, 1997). Finally, another study showed that students believed that increased global temperatures would lead to the wide-span desertification of the world (Francis et al., 1993).

While these examples highlight instances that require higher-level cognition, other studies have shown that students struggle with more fundamental concepts. For example, a study conducted by Lambert et al. revealed that student participants were confusing weather and climate (2012). In another study, researchers found that students were unable to distinguish between the differences of climate change, greenhouse effect and global warming (Boylan, 2008). Often times these misconceptions are supported by textbook visual depictions of these incorrect or simplified causal relationships or are not addressed by instructors (Shepardson, 2010).

Moreover, other studies have revealed misconceptions on climate change are based on generalized ideas about climate action. Students will often consider all environmentally friendly behavior as climate change action or, conversely, will consider all harmful environmental behavior as negatively attributing to climate change. For example, in investigating the understanding of elementary students around the remedies that will reduce the greenhouse effect, researchers found that students believed that ‘eating healthy foods’ would help reduce the greenhouse effect (Francis et al., 1993). Similarly, in a study that surveyed secondary students on the ‘cures’ to global warming, researchers found that students considered actions, such as, cleaning beaches as impacting global warming (Francis et al., 1993). The nearly two decades between the two studies highlight the pervasiveness of these ideas.

In these two examples of challenges to learning about climate change, it seems that the underlying issue may be the generalized approach with which students conceptualize climate change. Climate change is a highly complex topic area and it may be that in efforts to have a baseline understanding of it, students are creating rudimentary mental shortcuts (Rajeev Gowda et al., 1997). Unfortunately, this may lead to simplified mental constructs of climate change that leave out or blend climate science information.

### *Teacher Barriers: Misconceptions and Other Challenges*

Nonetheless, it is not only students that hold misconceptions around climate change, but it is also the instructors that are tasked with guiding student learning. Similar to students, instructors may also create simple schemes of global environmental problems and form incorrect causal relationships. When researchers investigated the conceptual framework Kindergarten teachers had around the most prominent environmental issues,

they learned that teachers were confusing the “ozone hole” with the “greenhouse effect” (Daskolia, 2016). Similarly, a different study that investigated the understanding that science middle school teachers had about climate change showed that they believed that insecticides, aerosols, and nuclear power generation were primary causes of climate change (Herman et al., 2017). In the survey administered to them, the teachers had claimed to cover climate change topic extensively within their classes.

Moreover, like students, some teachers believe that all environmentally behavior will lead to positive effects on climate change. For example, Groves and Pugh found that a majority of the pre-service primary teachers who participated in the study believed that keeping beaches clean would help “alleviate the greenhouse effect” (1999). In their findings, they also learned that teachers were correctly identifying actions that could reduce the greenhouse effect, but they were uncertain if the participants understood why these actions were beneficial. It is clear to see that the danger in misconceptions held by teachers is that they are can pass on these misconceptions to students, which, as a later study by Groves and Pugh identified is a present reality (2002).

The lack of knowledge that teachers have around climate change can be attributed to a few factors. First, it may be that teachers are not receiving enough training on this topic. A study carried out by Boon found that although pre-service teachers were more knowledgeable about the impact of the greenhouse effect on climate than students from a previous study conducted by the same researchers, there was no significant difference in their understanding of the science of the greenhouse effect (2010). The teachers had not received training on this topic area but posited that their knowledge may have been the result of greater engagement with media reports. Additionally, when in the classroom,

teachers may not have the pedagogical skillset to teach climate change or may not feel like they have the resources to successfully implement a course on climate change (Kim and Fortner, 2006; Sellmann & Bogner, 2013). As can be seen, the lack of preparedness or gaps in knowledge, manifest themselves into insecurities that can dissuade teachers from teaching about climate change.

### *Nature of Climate Change Education*

Although the previous examples suggest that the difficulty of student learning on climate change is largely centered on gaps in knowledge of both student and teacher, other research highlights that there are the cognitive barriers to learning about climate change. Studies dedicated to understanding why teaching climate change is difficult, point to its intangibility and interdisciplinary nature.

Students often struggle with understanding climate change because it is an abstract concept that may not be readily visible. A review on popular studies regarding the perception of individuals on risk revealed that individuals may not perceive a climate risk because they are not in close proximity to climate disasters (Weber, 2011). Similarly, when asked about the impact of climate change on humans, students from one study shared that climate change would not have a major impact on people of society. The students externalized any potential impacts to their life, as they also believed that it would be “wild” plants and animals that would be impacted by climate change events (Shepardson et al., 2011).. As these examples highlight, the hidden links between climate change and climatic events do not allow individuals to have a grounded understanding of climate change, as well as may encourage the removal of personal responsibility to partake in climate action.

Moreover, because climate change is a highly complex area, it requires a systems-thinking approach. Classrooms that implement climate change as part of their learning need to draw on different subjects to successfully integrate the unit. Although current science standards are moving towards this approach, implementing cross-curricular themes in order to teach about climate change units can be difficult. In the U.S., teaching typically operates in an egg crate, or siloed, fashion, wherein teachers are not collaborating with one another (Cohen, 1990). Teaching about climate change would also require professional development training to assist teachers in developing the pedagogical skillset to teach across disciplines (Chambers, 2011). Finally, it would require a move away from a factory model of teaching, to one that promotes knowledge construction and complex thinking. Francis et al. suggest that students would need to develop chain-thinking, in which a web of secondary, tertiary and higher order causes ground their understanding of linkages (1993).

### *Vulnerable Communities*

As the impacts of climate change become more disastrous, it is important to recognize which communities will be the most impacted by climate change. Within the U.S., the communities that have been, and will be, disproportionately negatively impacted are low-income communities and communities of color. A synthesis on literature regarding the social vulnerability of U.S. communities as a result of climate change produced by the United States Department of Agriculture referred to the work of Morello-Frosch et al. to understand how particular communities will be impacted by climate disasters (2011). They state that the lack of economic resources will place these communities in a ‘climate gap’; as climate prices for energy, food, and water increase,

low-income communities will have to spend a greater portion of their income to meet these needs.

Examples in recent memory highlight how climate change will be impacting low-income communities and communities of color. In August 2017, Hurricane Irma, a Category 5 hurricane, hit the Atlantic coastal communities of Florida. The impacts of hurricane encouraged what has now been coined climate gentrification, communities hit the hardest by climate disasters are forced to move out of their communities because they are unlivable (Mock, 2017). Two weeks later, Hurricane Maria hit Puerto Rico as a Category 4 storm. Four months after the hurricane 40% of the population was still without electricity with an estimated economic cost between \$45 and \$95 billion (Garcia, 2018). In a region where more than half of the population lives under the poverty line, the effects of a hurricane were more strongly felt.

## **Guiding Framework**

### *Socio-cultural Learning Approach*

The unit on climate change described below was designed with a social-cultural perspective on learning. Foundational theories on learning posit that learning is a social activity and occurs through the interaction with other individuals (Bransford et al., 2000). As theorized by Moll and Greenberg, learning is also embedded in a socio-cultural context of which bodies of knowledge, or funds of knowledge, are created and manipulated by those that make up that network (1990). It is through this network of relationships from which learners harness social resources to form and support their learning.

As future practitioners of science, the students that participated in the unit on climate change were undoubtedly be entering, what Cope calls a ‘community of practice’ (2013). As such, they have entered a social space where learning may be shaped, mediated or influenced by their social relationships with other practitioners -- their peers. In addition to recognizing that learning is a social activity, the unit is also positioned to respond and adapt according to the socio-cultural context within which is it situated. This was done intentionally because as studies have show, student learning is better supported when curriculum is culturally responsive (Arreguín-Anderson and Ruiz-Escalante, 2018).

Although English is not the official language of the United States, it has historically been used within the classroom as a form of assimilation particular populations. More specifically, the historical accounts of Latino families living in the U.S. reveal that Spanish was the language regulated to only home use because students would face punishment if used in the classroom. As such, English has been conceptualized as the as the language of academic success (Stevenson et al., 2014). The

findings by Stevenson et al. highlight that these notions of English as the language of academic success impact both teacher and the student behaviors, resulting in an “implicit institutionalized bias against Spanish” (Stevenson et al., 2014).

The socio-cultural part of learning has been embedded in this unit in various forms. First, the unit is entirely in Spanish. This design feature was employed to meet the programmatic mission of *En Nuestra Lengua*, but it also holds many benefits to the bilingual student user population. First, the use of Spanish is intended to affirm and expand student knowledge. A study conducted by Mensah et al. revealed that instruction given within the context of the sociocultural context of the student’s background validated student knowledge by connecting content to their interests and background (Mensah, 2009). Students were able to see their knowledge validated through its use in the content. Additionally, other studies have shown that when students are able to express their knowledge in their heritage language, they are able to practice their knowledge in different forms.

Moreover, examples of how the social part of learning manifests within this unit can be found within the in-class activities and the assessments. At various points throughout the course of the class, students are asked to participate in small and large group discussions. In these moments, students are drawing from their collective knowledge to expand their knowledge about the task or question at hand.

### *Constructivist Learning Approach*

The other learning theory guiding the construction of this unit is constructivism. At the base of this theory is that knowledge is constructed and regulated by the learner (Duckworth, 1972). Furthermore, learning is an active process that requires the learner to

build from their own mental representations of the world; knowledge does not come from an external source “ready-made” (Donaldson, 1978).

Using this approach to learning is a seamless fit for science learning for several reasons. First, it parallels the practices of scientists. One of the first practices that scientists engage in within the process of investigation, is asking questions and defining the problem (Songer, 2006). These questions are founded in observations made around a phenomenon. The initial stage of this process may not be linear, but iterative. Similarly, in constructivist learning theory, students are deepening their understanding around a certain topic based on their observations and questions they raise as a result (Hein, 1991). The weight of student-driven investigation around a phenomenon has gained enough traction to be implemented as science education standards set forth by the American Association for the Advancement of Science and the National Research Council (Marx et al., 2014).

Additionally, a constructivist approach to learning supports the cognitive engagement of students. In an exploration of inquiry-based instructional practices used on pre-service teachers, observations made on the pre-service teachers revealed their increasing fascination with their observations of phenomena -- the different phases of the moon ---- and their intellectual commitment to understanding particular questions that arose during their observations (Duckworth, 1972).

### *Multimedia*

Traditionally, learning in school environments revolve around one mode of learning: print, however, the nature of science learning requires that students engage with different media. For instance, from reading text on a topic area to interpreting

visualizations of data -- students need to be able to move across different media to create scientific meaning.

Employing multiple media offers many learning benefits. First, multimedia allow students different entry points into the content. As shared by ----, multimedia allow learners to make their understanding visible by engaging in learning expressions that fit with their form of understanding. As Vasudevan et al. (2014) put it, multimedia makes “visible [student] articulations and expressions of curiosity about the world”. The process of having options by which to engage in allows students to have ownership over their learning have an authorial stance in how they communicate their knowledge -- allowing them to build their academic identity. Additionally, it allows students to connect their out-of-school knowledge and interests into the classroom (Vasudevan et al, 2010). Finally, given the audience of the unit, multiple modalities may be particularly helpful given the varying levels of Spanish mastery amongst the potential learners of this unit.

## **Unit Implementation**

To investigate what a curriculum for climate change education for primary students would look like, a partnership with the Ann Arbor-based Spanish literacy program, En Nuestra Lengua (ENL), was formed. En Nuestra Lengua was initiated as a proof-of-concept project in 2010 with the goal of developing the academic skills in Spanish for students whose home language is Spanish. The volunteer-run program began with 30 and has had 200+ students enrolled.

En Nuestra Lengua holds classes on Saturday for pre-kindergarten to 4<sup>th</sup> grade and covers a number of subject areas including math, Spanish grammar, and science during their 180-minute academic day. During this time, students are completely immersed in Spanish. Everything from classroom discussions, and conversations held in the hallway or at the school entrance are encouraged to be completely in Spanish. The curriculum has been developed by learning specialists and includes cultural themes of Latin America. Finally, ENL currently follows the public academic calendar with the ENL academic calendar split into three semesters: Fall, Winter, and Spring.

In order to enroll in the program, parents must submit an application. Families are later invited to the school-site so that students can participate in an academic evaluation which will determine in which grade-level they will be entered within ENL. The process of grade-matching considers the student's grade level in their regular school, their age, their mastery of the Spanish language, and whether they have completed previous semester with ENL. Once matched, students are placed in classrooms with students of a similar academic level.

While program materials and enrollment are cost-free to the families, the program does require a full commitment in all academic programming. Additionally, parents are

required to attend 2-3 ENL-led workshops. Outside of these requirements, the program hosts various community programs, such a group exercise, and cultural events, such as a Christmas celebration, open to the entire community of ENL to foster community cohesion. Parents are also invited to volunteer in various capacities within the program.

A total of 13 students ages 9-11 participated in the unit. The students represented grades 3-5, with the majority of students being in fourth grade. All students were Spanish heritage speakers with varying levels of Spanish-speaking abilities. Most students had already participated in previous semesters of En Nuestra Lengua. Students have familial connections to various countries in Latin America as well as other countries around the world.

### *Curriculum Design*

The curriculum on climate change was developed to span the course of six weeks. Over those six weeks, students were guided through short lessons on different climate change topics, which included establishing student conceptualization of the environment, discovering the source of solar energy, understanding the relationship between solar energy and earth, identifying the effects of increased greenhouse gases rate, and exploring climate action.

The learning goals for the lesson were as follows. After participating in the course, students would be able to recall new vocabulary; describe the source of greenhouse gas generation; identify consequences of increased rates of greenhouse gas emissions and; describe actions to address climate change. To help support student learning, the unit also included short in-class lessons on the topic, homework assignments, parent presentations, and an out-of-school partnership that resulted in an art

project. The lessons were 15-30 minutes long and were typically situated in the middle of the class day at En Nuestra Lengua.

### *In-Class Lessons*

In developing the lessons, the goal was to develop lesson plans that would help support students with the acquisition of vocabulary and mental maps to understand climate change. As mentioned, five lessons were developed in relation to student conceptualization of the environment, discovering the source of solar energy, understanding the relationship between solar energy and earth, identifying the effects of increased greenhouse gases rate, and exploring climate action. Lessons were guided by a question, such as “What causes climate change” and included a short lesson on the topic. Students were given vocabulary sheets to help them remember key terms. Additionally, throughout the course, I different media, mainly text and video, to communicate different ideas around climate change.

### *Homework Assignments*

The homework assigned included four worksheets that complemented the lesson plans covered in class. The worksheets can be found in the appendices but will also be described. The first two worksheets were designed to help students reflect on their own understanding of the environment, as well as that of their family. As shared previously, my approach in designing this course was from a socio-constructive perspective and I viewed these moments of reflection as students accessing their family’s collective knowledge on, as well as students rebuilding their own. The first homework worksheet was “Discover Nature/*Descubre la naturaleza*” which asked students to do a sensory

exploration of their environment and document their findings. The second worksheet was “New Perspective/*Nueva perspectiva*” which asked students to play the role of a newspaper writer and interview their parent regarding their experiences with nature. Students would then write a short ‘article’ based on the interview, in addition to writing a short autobiography. The third worksheet, titled “Our World/*Nuestro mundo*” was a fill-in-the-blank assignment that reviewed key terms covered in class. Finally, the last two worksheets “Greenhouse Gas/*Gas de efecto invernadero*,” and “Climate Change: Cause and Effect/ *Cambio Climatico: causa y efecto*” were, like the previous worksheet, aimed at assisting students to review concepts covered in class.

In reviewing the first homework assignment (*Discover Nature/Descubre la naturaleza*) students turned in I gained insight into how they conceptualized the natural environment. One of the prompts asked how they felt in exploring the environmental space they chose. Some students wrote about the emotion it gave them: I am very very very happy/ *Estoy muy muy muy feliz*; I feel happy and relaxed, tranquil its peace and tranquility/*Me siento feliz y relajada, tranquila es pas y tranquilidad*; and when I am in nature it makes me feel happy/*cuando estoy en la naturaleza me hace sentir feliz*. One student chose to write about what they were feeling physically and the movement they saw: I feel heat. Also the air. And the trees moving/ *siento calor. Tambien siento el aire. Y los arboles moviendo*. In another prompt that asked why nature was important to them, most students answered from a mostly utilitarian perspective: the trees give me oxygen. the plants feed me and others cure me. In nature I find water and food/*los arboles me dan oxigeno. las plantas me alimentan y otras me curan enfermedades. En la naturaleza*

*enquentro agua y comida.*; and, similarly, the elements of nature allows us to live well/*los elementos de la naturaleza nos permiten vivir bien.*

The next assignment (New Perspective/*Nueva perspectiva*) students were able to share the connections that their family has to other places. Students wrote about the lives of their parents in places such as Colombia, Puerto Rico, France, New Hampshire, and Mexico. Collectively, the student's stories spoke of diverse ecological systems and rich environmental memories. One student shared how their mother would play with their cousins in a waterfall that was located in their neighborhood. Another student described the route that their father would take along coffee plantations. This student shared that enjoyed the ride along the coffee plantations because the coffee was like an 'alfombra', rug, covering the route. Finally, another student described the play her mother would do with nature. The student writes "*se juntaba con sus amigos y jugaban ha recolectar hojas bonitas de distintos colores y formas. Despues las pegaban en un cuaderno para hacer un album ecologico*/she would gather with her friends and would play collecting beautiful leaves of distinct colors and forms. Afterward, they would stick them in a journal to make an ecological album."

The next worksheet revealed some of the misconceptions that students held. For example in "Greenhouse Gas/*Gas de efecto invernadero*" the last question asked what human activities are causing an increase in the number of greenhouse gases, to which some students misidentified causes including aerosols and trash. Next, although students were able to complete the following two worksheets "Greenhouse Gas/*Gas de efecto invernadero*" and "Climate Change: Cause and Effect/ *Cambio Climatico: causa y efecto*" was not designed in a way that matched the learning in class discussions.

### *Parent Presentations and Out-of-School Partnership*

In staying in line with the socio-cultural grounding of the lessons, parent presentations were included as an extension of the class. As routinely done with other classes in ENL, parents were going to make a short presentation on their subject of choice to the students. For our course, parents were going present on topics related to the environment more generally. Although our intention was to have a parent present after each class, I was able to only collaborate with one parent. The presentation was held at the beginning of the course, which fit in nicely with the theme of ‘conceptualization of the environment.’ The parent chose to do a presentation on the different ecosystems that they had explored in Latin America by compiling different images. The prompted students with various on what they saw and aimed to connect with students by inviting experiences students may have had in similar places. Similar to the first two homework assignments, the parent presentation helped identify the collective knowledge that students and their families held about different ecosystems.

Next, at the beginning of the semester our students were invited to participate in a local competition hosted by a university student organization, ArtEco, on the theme of actions students can take to combat climate change. All students in our class participated and submitted drawings that depicted actions that they would take to combat climate change; these drawings were completed at home. Towards the end of the semester, winners were announced, and three of our students were selected as winners. The students were recognized during our class.

### *Assessment*

To assess student learning gains, a pre- and post-test were administered. The test included ten questions, which included multiple choice, short responses and fill in the blank questions. Distractors were also included in the questions. The question on the pre- and post-test were kept consistent for comparability. The test was developed in partnership with the director of En Nuestra Lengua.

### *Assessment Results*

Before participating in the course, students scored an average of 36% (7.2/20), and post-test student average score was 84% (16.8/20). The post-test revealed a 9-point learning gain.

The greatest gains were in the student's ability to identify sources of energy; the spatial location of greenhouse gases; and the characteristic of a greenhouse gas. The questions that the students had the most difficulty answering were causes for an increase in global temperature, defining climate change, identifying the impact of climatic events on their life, and identifying climate actions.

In reviewing their open-response questions and comparing homework assignments, a few distinctions of student climate change understanding were revealed. First, students struggled with identifying the difference between weather and climate. In reviewing the content submitted for their art project on climate change, some students had drawn images of the seasons. Within our in-class discussions, I had not included the function of time in distinguishing climate from weather, as a result, students were interpreting weather as climate, or were using previous knowledge about atmospheric science as a framework to understand climate change.

Finally, it became clear that there was still confusion around climate actions. Students were interpreting all environmentally friendly behavior as climate actions. For example, in the exam students cited: using less paper, recycling, or littering as climate actions. Additionally, some student interpreted the question incorrectly. For example, the question on climate action asked students to identify actions they would take to combat climate change. For example, in the case of drought, one student stated that individuals should “drink water/*tomar mucha agua si hay sequia*”. Similarly, a different student stated that we should not use gas/*no usar mucha gas.*” These challenges were similar to those which students faced within the literature review.

## **Limitations and Recommendations**

In reflecting on the preparation and execution of the course, I have created a list of future course improvements.

1. **Assessing prior of knowledge** - In addition to identifying learning gains, the pre-test was intended to assess student prior knowledge around climate change. The test was coupled with a concept map that I had students generate the first day of class to better understand student prior knowledge around climate change and nature. These tools were helpful in revealing what perceptions students held of the environment and climate change, however, it did not reveal the extent of student knowledge. An assessment that is student-centered and more qualitative in nature would have provided a deeper understanding of the knowledge students had around climate change. In future climate change education course developments a *KWL chart would be beneficial* to use because it assesses student knowledge around a particular topic; engages student metacognitive thinking around gaps in their knowledge, and; finally, it helps document learning students have achieved in the subject area. Most importantly, the KWL chart is entirely student-generated, which may support student engagement and motivation in learning about the topic.

2. **Identifying Learning Differentiation** - As mentioned, our class had students of varying age levels, grades, and Spanish language mastery. I found that some students had a difficult time participating in in-class discussions because they did not have the language skill set to do so. Typically, these students would remain quiet during class, and it was in speaking to the other in-class instructor when I learned more about the areas in which students were struggling. Similarly, students that had a strong mastery of the language and/or the concepts would over-participate during in-class discussions. To

equalize participation during in-class discussions, I would select on different students. When I initially designed the curriculum, I did not have an eye towards these differences. *Future lessons and assignments should include scaffolds* to support students struggling with concepts, *extensions* for students that have a stronger mastery of the concepts covered, and identify *alternatives forms of participation* for students that have limited Spanish-language skills.

3. **Homework Support:** As outlined above, students answered assignments questions in ways that were not intended. *Future homework worksheets should include additional prompts* to better support students in completing assignments. Some assignments, such as the nature exploration assignment, might require a time component. Additionally, expectations for the assignment should be made clear during class. Finally, checking in with the students the following week on how they felt about the insight would provide additional insight into the level of difficulty or challenges they came across.

4. **Cross-curricular Collaboration:** Extending from the last recommendation, my lessons were typically completed independently of the other subject areas covered by the other in-class instructor. Given the overlap, especially within the area of Spanish grammar, *future science lessons should be cross-curricular* and incorporate skills being practiced by students within the other subject areas. Additionally, this approach would support a less disruptive transition between one subject area to the next.

5. **Educative Resources** – As mentioned, En Nuestra Lengua works with a number of volunteers to run its programming, therefore it is important that the *lesson plans include resources to support future instructors* leading the lesson plans. While

delivering lesson

plans and having students ask me questions, I came to realize that I had gaps in my own knowledge about climate change. Educative resources can include resources to learn more about the subject area in addition to suggestions for alternative instructional strategies.

6. **Weather Precursor Course:** As mentioned, students struggled to learn about climate change and I believe that it was because there were foundational concepts that we did not cover that would have been beneficial in their learning about climate change. Additionally, some climate change concepts required that the students have a richer understanding of complex causal relationships. It would be beneficial if the students had a *precursor course* to help them develop and practice their skill set.

## **Summary**

With an increasing push to include climate change as part of the K-12 education, more climate change curricula have entered the classroom. However, there are few curricula that are culturally responsive. The objective of this practicum was to develop a unit on climate change for a Spanish literacy program, En Nuestra Lengua (ENL) that helped students understand key concepts around climate change. I used a socio-constructivist approach to developing the lesson plans and worked in partnership with ENL to implement the educational experiences in their program. In reviewing the different elements of the lesson plans, it became clear that the unit had mixed success.

Although students were able to make knowledge gains, some misconceptions still persisted. A list of recommendations and updates to the course lesson plans were made.

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## Appendix

### *Original Lesson Plans 1-5*

#### Lesson 1: Nature Appreciation

##### Agenda

1. Introduction (5 minutes)
  - a. Purpose of the class:
    - i. We want to explore nature, learn what harms it, and what actions we can take. We will also be describing climate change,
  - b. Overview of the course
    - i. Each week we will cover a different aspect about nature, we will be having hands on activities and field trips to guide you in understanding nature
  - c. Expectations & Rules
    - i. Homework every week
    - ii. The homework calendar has been/will be given to you
  - d. Homework and Hw Prizes
    - i. Every week you will receive a stamp/sticker for the homework that you complete. At the end there will be prizes for the ones that completed the homework
2. Content
  - a. Evaluation (10 minutes)
  - b. Activity (10 minutes)
    - i. Introduction about nature by reviewing the homework worksheet
    - ii. Create a collective image of nature: we will be using sticky notes to write description of the place they visited in nature
3. Homework:
  - a. Ficha: Descubre la naturaleza
4. Parent presentation:
  - a. Nature in home country: Parent will describe their favorite natural places in their home country

## Lección 2: ¿Qué es el cambio climático?

### Objetivo:

- Los estudiantes aprenderán la definición de un gas de efecto invernadero
- Los estudiantes hablarán sobre los diferentes tipos de gases de efecto invernadero
- Los estudiantes aprenderán sobre las consecuencias del aumento de los gases de efecto invernadero
- Los estudiantes aprenderán a nombrar gases de efecto invernadero

### Vocabulario:

- Gases de efecto invernadero
- Atmósfera
- Gases: dióxido de carbon y metano
- Cambio climático

### Agenda

1. Repaso de la tarea (5 min)
  - a. Preguntas
    - i. ¿Qué aprendiste?
2. Repase su comprensión del cambio climático (5 min)
  - a. Preguntar:
    - i. ¿Qué sabes sobre el cambio climático?
    - ii. ¿Qué causa el cambio climático?
3. [Video](#) sobre los gases de efecto invernadero y discusión (10 min)
  - a. Preguntas:
    - i. ¿Qué son los gases de efecto invernadero?
    - ii. ¿Cuál es la función de los gases de efecto invernadero?
    - iii. ¿Qué sucede cuando hay muchos gases de efecto invernadero?
    - iv. ¿De dónde vienen los gases de efecto invernadero?
4. Tarea
  - a. Ficha sobre los gases de efecto invernadero

## Lección 3: ¿Qué es lo que causa el cambio climático?

### Objetivo

- Los estudiantes definirán el gas de efecto invernadero
- Los estudiantes describirán el proceso de los gases de efecto invernadero
- Los estudiantes describirán dos consecuencias del aumento de los gases de efecto invernadero
- Los estudiantes nombran tres gases de efecto invernadero
- Los estudiantes practicarán el nuevo vocabulario

### Vocabulario

- Gases de efecto invernadero
- Greenhouse
- Gases: dióxido de carbon, metano, y óxido nitroso
- Absorbe
- Emite

### Materiales

- Bufandas
- Calcomanías para la tabla de progreso

### Agenda

- I. Apertura (10 min)
  - A. Bienvenida
  - B. Revisar la tarea de la semana pasada
  - C. Presentar la nueva tarea
- II. Revisión gases de efecto invernadero (5 min)
  - A. La última vez vimos un video que nos dio una breve descripción de la definición de cambio climático y comenzamos a hablar sobre la definición de ciertas palabras
  - B. Vamos a repasar algunas palabras:
    1. Efecto invernadero
      - a) ¿Qué significa invernadero?
      - b) Notas para priscila: Quizás llevar en un ejemplo de lo que sucede? Tal vez una botella de agua con condensación?
    2. Atmósfera
      - a) Capa (preguntar: ¿qué es una capa?)
    3. gas de efecto invernadero
      - a) Hemos visto esta palabra antes, ¿qué crees que significa toda la palabra? ¿Qué es un gas? ¿Qué es un gas de efecto invernadero? Qué propósito sirven estos gases?
      - b) ¿Que pasa cuando hay muchos gases de efecto invernadero?
        - (1) Voy a hacer una mini presentación usando las bufandas
      - c) ¿De dónde vienen los gases de efecto invernadero?

III. Cierre: Explicar la mini-excursión

## Lección 4: REPASO ¿Qué es lo que causa el cambio climático?

### Objetivo

- Los estudiantes definirán el significado de gas de efecto invernadero
- Los estudiantes describirán el proceso de los gases de efecto invernadero
- Los estudiantes nombran tres gases de efecto invernadero

### Vocabulario

- Gases de efecto invernadero
- Efecto invernadero
- Invernadero
- Gases: dióxido de carbon, metano, y óxido nitroso
- Cambio climático
- Absorbe
- Emite

### Materiales

- Bufandas
- Calcomanías para la tabla de progreso

### Agenda

- I. Apertura (3 min)
  - A. Bienvenida
  - B. Tarea
- II. Repaso de vocabulario (15 min)
  - A. Word cluster 1: Efecto invernadero, gas de efecto invernadero
    1. ¿Qué significa invernadero?
      - a) Los invernaderos son estructuras que tienen la capacidad de generar condiciones de temperatura y humedad ideales para cultivar plantas durante el invierno, o en sectores donde las condiciones climáticas son muy adversas.
      - b) Palabra clave INVIERNO = Invernadero
    - B. Efecto invernadero
      1. ¿Qué significa efecto invernadero?
      2. Significado: fenómeno natural por cual ciertos gases retienen parte de la energía solar
    - C. Gas de efecto invernadero
      1. ¿Qué crees que significa toda la expresión? ¿Qué es un gas? ¿Qué propósito gases cumplen?
        - a) Calientan
      2. ¿Que pasa cuando hay demasiada cantidad de gases de efecto invernadero?
        - a) Mini presentación usando las bufandas
      3. Tipos de GEI
        - a) ¿Cómo se producen los gases de efecto invernadero?
  - III. Actividad: Energía solar - word cluster 2: cambio climático
    - A. ¿Qué significa “climático”?

1. Climático = clima ; clima y las estaciones del año
  2. ¿Qué son ejemplos de estaciones de año?
  3. ¿Nos importa si la Tierra se está calentando?
  4. ¿Por qué está cambiando el clima?
    - a) Relacionar con los GEI
    - b) Actividades humanas
- IV. Cierre: Repaso de las instrucciones de la tarea
- A. ¿Preguntas?

## Lección 5: Consecuencias y Acciones

### Objetivo

- Estudiantes podrán identificar acciones para combatir el cambio climático

### Vocabulario

- Mitigatar
- Adaptar

### Materiales

- Proyector

### Agenda

- I. Introducción
  - A. Bienvenida
- II. Transición
  - A. Revisar la tarea de la semana pasada
  - B. Presentar la nueva tarea
- III. Repaso de la semana pasado
  - A. Consecuencias del cambio climático y significado de cambio climático y gases de efecto invernadero
- IV. Ver video sobre sobre la princesa
  - A. ¿Qué desastres ocurrieron?
    1. ¿Han visto desastres similares en las noticias?
  - B. ¿Qué acciones tomó la princesa?
  - C. Actividad: Toma 3 minutos y contesta:
    1. ¿Qué medidas puedes tomar para combatir el cambio climático?

## Evaluación

**Instrucciones:** Lea cada pregunta con cuidado. Luego responda con la respuesta correcta.

**EJEMPLO:** Seleccione la respuesta correcta.

La “cumbia” es

- A. Una comida
- B. Un baile
- C. Un juego
- D. Un animal

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Use la imagen abajo para responder las preguntas 1 y 2 :

1. (1 pto) ¿De dónde vienen los rayos que calientan la Tierra?

Los rayos que calientan la Tierra vienen de

\_\_\_\_\_

2. (1 pto) ¿Dónde existen los gases de efecto invernadero?

Los gases de efecto invernadero existen en

\_\_\_\_\_

3. (1 pto) ¿Cuál **NO** es un gas de efecto invernadero? **Seleccione la respuesta correcta:**

- A. Vapor de agua
- B. Metano
- C. Gasolina
- D. Dióxido de carbon

4. (1 pto) ¿**Verdadero o Falso?** “Un gas de efecto invernadero es un *gas atmosférico* que **absorbe** y **emite** radiación solar.”

- A. Verdadero
- B. Falso

5. (2 ptos) **Rellene cada espacio con la palabra correcta de la lista:** grande / enfría / pequeña / caliente

“El planeta se \_\_\_\_\_ cuando hay una cantidad \_\_\_\_\_ de gases de efecto

Invernadero.”

6. (3 ptos) **Seleccione lo que aplique de las opciones A, B, C, o D. Escriba las respuestas en las líneas de abajo.**

- |    |              |    |            |    |           |    |             |
|----|--------------|----|------------|----|-----------|----|-------------|
| A. | La ganadería | B. | El uso de  | C. | El uso de | D. | La          |
|    |              |    | Transporte |    | una       |    | agricultura |
|    |              |    |            |    | bicicleta |    | de escala   |
|    |              |    |            |    |           |    | grande      |

7. (1 pto) ¿Qué

es lo que está **causando** el aumento de la temperatura en la Tierra? **Seleccione la respuesta correcta:**

- A. El aumento de los Gases de Efecto Invernadero.
- B. El aumento de la radiación proveniente del Sol.

C. El aumento del número de incendios forestales.

8. (1 pto) ¿Qué es el *cambio climático*? **Seleccione la respuesta correcta:**

- A. Las diferencias y variaciones del clima general en la Tierra.
- B. El aumento de la ocurrencia de huracanes.
- C. Las variaciones en algunos factores que componen el clima de un año a otro.

9. (4ptos) ¿Cómo nos afecta el cambio climático? Elija **2** de las consecuencias y describe cómo le afecta a usted.

A) Sequía _____ _____ _____ _____ _____	B) Aumento del nivel del mar _____ _____ _____ _____ _____
C) Deshielo de los glaciares _____ _____ _____ _____ _____	D) Inundaciones _____ _____ _____ _____ _____

10. (4 ptos) ¿Qué acciones puede usted tomar para combatir el cambio climático? **Apunte 2 acciones:**

A. \_\_\_\_\_  
\_\_\_\_\_

B. \_\_\_\_\_  
\_\_\_\_\_

Nombre: \_\_\_\_\_

### **Ficha 1: Descubre la naturaleza**

Bienvenidos! Durante el próximo semestre estarás aprendiendo sobre la naturaleza, lo que daña la naturaleza, y las acciones que puedes tomar para cuidar la naturaleza. Primero aprenderemos sobre lo que es la naturaleza.

Lee y contesta lo siguiente.

#### **¿Qué es naturaleza?**

El término naturaleza tiene un significado más general, y hace referencia al conjunto de todos los organismos vivientes que conforman el universo físico que se han dado de manera natural. Por ejemplo, describe las plantas y los animales, y a veces el clima o la geología.

Describe otros elementos de la naturaleza.

Otros elementos de la naturaleza

incluyen \_\_\_\_\_

\_\_\_\_\_

#### **¿Dónde existe la naturaleza?**

La naturaleza existe en todo tu alrededor. Puede existir en la selva de la Amazonía, tal como en el patio de tu casa. La naturaleza está en cualquier parte, solo hay que aprender a verla.

¿En qué otros lugares existe la naturaleza?

La naturaleza existe en

\_\_\_\_\_

\_\_\_\_\_

#### **¿Por qué es importante la naturaleza?**

La naturaleza es importante por varias razones. La naturaleza nos provee con los elementos que nos ayuda a vivir. Por ejemplo, nos provee agua para tomar, comida para comer, los recursos naturales para construir nuestras casas, y oxígeno para respirar, pero nos provee mucho más.

¿Por qué es importante la naturaleza para ti?

La naturaleza es importante para mí porque

\_\_\_\_\_

---

Aprendimos sobre diferentes elementos de la naturaleza, ahora estamos listos para empezar nuestras investigaciones iniciales de la naturaleza. Estaremos usando los sentidos de la vista, el olfato, el oído, y el tacto, para explorar la naturaleza. Con un adulto, busca un lugar en la naturaleza para realizar tus exploraciones de la naturaleza y describe lo siguiente:

Describe lo que <b>ves</b> en la naturaleza:	Describe lo que <b>oyes</b> en la naturaleza:
Describe lo que <b>hueles</b> en la naturaleza:	Describe lo que <b>tocas</b> en la naturaleza:

Dibuja una imagen del lugar en la naturaleza que exploras:



En una oración describe lo que te hace sentir al estar en este lugar en la naturaleza.

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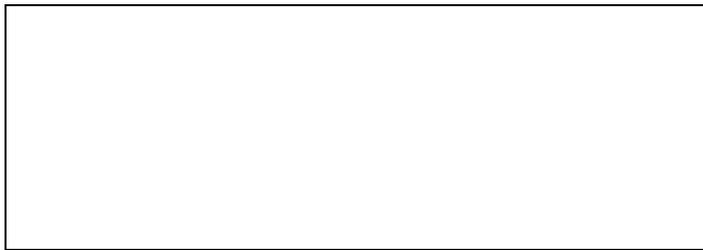
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### **Sobre el autor**



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Lección 3: Tarea

Nombre: \_\_\_\_\_

**Ficha 3: Nuestro mundo**

Instrucciones: Use las palabras en la parte inferior de esta hoja para completar las oraciones.

Los patrones climáticos de nuestro planeta están cambiando porque los humanos están creando gases que causan demasiado calor como para quedar atrapados en nuestro \_\_\_\_\_. Llamamos a estos gases 'gases de efecto invernadero' e incluyen \_\_\_\_\_, \_\_\_\_\_ y \_\_\_\_\_. Es importante recordar que el planeta siempre ha tenido gases de efecto invernadero en su atmósfera y que han desempeñado un papel importante en calentar el planeta lo suficiente como para sostener \_\_\_\_\_. Desafortunadamente (desde los 1800s) hemos comenzado a producir cantidades adicionales de gases de efecto invernadero que han alterado el equilibrio natural de la temperatura global del planeta y están causando que demasiado calor quede atrapado en nuestra atmósfera. El gas que \_\_\_\_\_ creen que causa el mayor daño es \_\_\_\_\_ (CO<sub>2</sub>), que se produce cuando quemamos combustibles fósiles como gasolina. El calentamiento global podría cambiar nuestros patrones climáticos normales haciéndolos más extremos, lo que puede causar más escasez de agua, tormentas, inundaciones y niveles de \_\_\_\_\_ cada vez más altos. Tenemos que trabajar juntos al nivel de nuestra comunidad, ya sea en el trabajo, en el hogar o en la \_\_\_\_\_, para minimizar el impacto que generamos

Atmósfera	Escuela	Dióxido de carbon
Dióxido de carbón	Metano	Vida
Científicos	Agua	Vapor de agua

Lección 4: Tarea

Nombre \_\_\_\_\_

**Ficha 4: Gas de efecto invernadero**

Instrucciones: Conteste las siguientes preguntas.

1. ¿Qué radiación emite el sol ?
2. La radiación solar pasa a través de la \_\_\_\_\_ de la Tierra y llega hasta la superficie de la Tierra.
3. ¿Qué gases atmosféricos evitan que escape el calor?
4. Esto se debe a que estos gases (absorben / reflejan / transmiten) el calor.
5. Cuando la radiación solar pasa a través de algo, esto significa que es  
absorbido / reflejado / transmitido
6. Cuando la radiación solar toca la superficie de la Tierra, parte de ella es devuelta al espacio. Esto significa que ha sido  
absorbido / reflejado / transmitido
7. Parte de la radiación solar que llega a la superficie de la Tierra se refleja de vuelta al espacio. Esto significa que ha sido absorbido / reflejado / transmitido
8. ¿Qué actividades humanas han causado un aumento en gases de efecto invernadero?
9. ¿Qué gas ha aumentado debido a los humanos? \_\_\_\_\_
10. ¿Cómo ha cambiado el clima de la Tierra en los últimos 150 años?

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Nombre: \_\_\_\_\_

**Ficha 5 - Cambio climático: Causa y efecto**

Instrucciones: Lee lo siguiente y después contesta las preguntas

Los **gases de efecto invernadero** (GEI) son los gases que atrapan el calor en la atmósfera. El proceso de calentamiento es conocido como **efecto invernadero**. El efecto invernadero es un fenómeno natural, pero las actividades humanas han aumentado la cantidad de gases de efecto invernadero en la atmósfera, cambiando el clima. El cambio de clima es conocido como cambio climático. Lo siguiente son algunas causas y consecuencias del cambio climático.

CAUSA ¿Que actividades humanas generan gases de efecto invernadero (GEI)?

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

EFEECTO - ¿Cuáles son las consecuencias del cambio climático?

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

Deforestación	Autos	Sequía	Ganadería	Inundaciones
Deshielo de los glaciares	Incendios forestales	Aumento del nivel de agua		
Agricultura	Industria			

Updated Lesson Plans

Lesson 1: Pre-course Evaluation

<b>Subject/ Grade Level:</b> Earth Science - 4th grade	<b>Class Length:</b> 20 minutes
<b>Science Standards:</b> 4-ESS3-1 Earth and Human Activity: Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. 4-ESS3-2 Earth and Human Activity: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.	<b>Materials:</b> <ul style="list-style-type: none"> <li>• Exam</li> </ul>
	<b>Safety Notes:</b> NONE
<b>Lesson Objective(s):</b> None, students will be taking assessment	
<b>Today's activities</b>	
<b>Description of activity:</b> <ol style="list-style-type: none"> <li>1. <b>4 minutes - Introduction</b> <ol style="list-style-type: none"> <li>a. Introduce who you are and inform students that they will be taking an evaluation to identify what they know about climate change. Note: Although this is an assessment to identify student understanding, students get nervous. Previous</li> </ol> </li> <li><b>15 minutes - Pre-course Evaluation</b> <ol style="list-style-type: none"> <li>a. Have a student read instructions out loud and ask the class whether they understand the instructions. Remind them to write their name at the top and inform them that there is a backside to the evaluation. Students should be completing the entire evaluation and will have 15 minutes to complete it.</li> <li>b. Once students have started the evaluation, occasionally inform them about the time they have left.</li> </ol> </li> <li><b>1 minute - Conclude</b> <ol style="list-style-type: none"> <li>a. Collect exams from students and distribute homework. Thank students for participating in the first day of class and share excitement about working with them next week and over the course of the semester. Let me know that next week they will be doing introductions.</li> </ol> </li> </ol>	
<b>Homework:</b> Discovering Nature	

Lesson 1: Homework

Name: \_\_\_\_\_

**Discover Nature**

Welcome! During the next semester you will be learning about nature, what damages nature, and the actions you can take to take care of nature. First, we will learn about what nature is.

Read and answer the following.

**What is nature?**

The term nature has a more general meaning and refers to all living organisms that make up the physical universe. For example, it describes plants and animals, and sometimes climate or geology.

Describe other elements of nature. Other elements of nature include \_\_\_\_\_

\_\_\_\_\_

**Where does nature exist?**

Nature exists all around you. It can exist in the jungle of the Amazon, just like in the patio of your house.

What other places does nature exist?

Nature exists in \_\_\_\_\_

\_\_\_\_\_

**Why is nature important?**

Nature is important for several reasons. Nature provides us with the elements that help us to live.

Why is nature important to you?

Nature is important to me because

\_\_\_\_\_

\_\_\_\_\_

We learned about different elements of nature, now we are ready to start our initial investigations of nature. We will be using the senses of sight, smell, hearing, and touch, to explore nature. With an adult, look for a place in nature to perform your explorations of nature and describe the following:

Describe what you <b>see</b> in nature:	Describe what you <b>hear</b> in nature:
Describe what you <b>smell</b> in nature:	Describe what you <b>touch</b> in nature:

Draw an image of the place in nature that you explore:

In a sentence, describe what you feel to be in this place in nature.

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Lesson 2: What do you know about nature?

<b>Subject/ Grade Level:</b> Earth Science - 4th grade	<b>Class Length:</b> 15 minutes
<b>Science Standards:</b> 4-ESS3-1 Earth and Human Activity: Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. 4-ESS3-2 Earth and Human Activity: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.	<b>Materials:</b> <ul style="list-style-type: none"> <li>• Blank sheets of paper</li> <li>• Giant sticky note and marker</li> </ul>
	<b>Safety Notes:</b> NONE
<b>Lesson Objective(s):</b> <ul style="list-style-type: none"> <li>• Students will have shared their prior experiences with nature</li> </ul>	
<b>Today's activities</b>	
<b>Description of activity:</b> <ol style="list-style-type: none"> <li>1. <b>5 minutes</b> - Introduction           <ol style="list-style-type: none"> <li>i. Re-introduce yourself</li> <li>ii. Purpose of the class: We want to explore nature, learn what harms it, and what actions we can take. We will be using climate change to learn about these things.</li> <li>iii. Overview of the course Each week we will cover a different aspect of climate change, additionally we will have hands-on activities and, might have a field trip.</li> <li>iv. Expectations &amp; Rules There will be homework every week. Please make sure to come prepared with it because it will be part of the lesson. The homework calendar has been/will be given to you</li> <li>v. Optional: Homework and Homework Prizes Prizes are optional, but if you choose to incorporate this, inform students that every week they will receive a stamp/sticker for the homework that they complete. At the end of the class, there will be prizes for the ones that completed the homework.</li> </ol> </li> <li><b>15 minutes - Prior experience with climate change</b> <ol style="list-style-type: none"> <li>a. <b>4 minutes - Review the homework worksheet</b> <ol style="list-style-type: none"> <li>i. Review the assignment and ask students who would like to share.</li> <li>ii. After receiving 2-3 shareouts transition into the KWL chart.</li> </ol> </li> <li>b. <b>5 minutes - Student Concept Map</b> <ol style="list-style-type: none"> <li>i. Hand each student a black piece of paper and tell them that they will have 5 minutes to make a bubble map with what they know about climate change. Share that this is important for what they will do next. Also, share that even if they aren't sure if what they are writing down is correct, they should still write it down. Possibly consider doing an example of a concept map on the board. The example could be that of a dog and you can attach bubbles such as characteristics of a dog, where you might find one, the different types of dogs there are, etc.</li> <li>ii. Keep a time check for the students and collect the concept maps from them. Thank them and transition into the next activity.</li> </ol> </li> </ol> </li> </ol>	

<p>c. <b>6 minutes - KWL Chart</b></p> <p>i. Introduce the KWL chart and ask for a volunteer to share what the function of a KWL chart is. Students should have seen the KWL chart in their previous semester.</p> <p>ii. Reinroduce the KWL chart and ask students what they know about climate change. Guide them through the chart and ask them to write their responses on sticky notes that they will add to the KWL chart.</p>
<p>Parent presentation:</p> <ul style="list-style-type: none"> <li>• Nature in home country: Parent will describe their favorite natural places in their home country</li> </ul>
<p>Homework:</p> <p>Worksheet 2: New Perspective</p>

Resources

**Know, Want to Know, Learned (K-W-L) Chart**

K	W	L

The K-W-L chart was developed as a reading instructional strategy and has been used to guide learning in other subject areas. It has several purposes, including eliciting students’ prior knowledge on a topic, problem or phenomenon (K), setting a goal for learning (W), and helping students monitor their understanding of the topic, problem or phenomenon (L).

References: <http://www.nea.org/tools/k-w-l-know-want-to-know-learned.html>





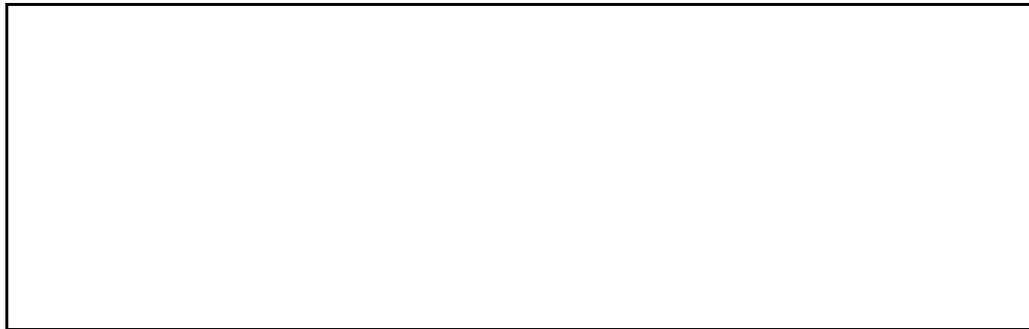
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### **About the author**



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Lesson 3: What is climate?

<b>Subject/ Grade Level:</b> Earth Science - 4th grade	<b>Class Length:</b> 20-25 minutes
<p><b>Science Standards:</b>            4-ESS3-1 Earth and Human Activity: Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.            4-ESS3-2 Earth and Human Activity: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.            5-ESS3-1 Earth and Human Activity: Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment.</p>	<p><b>Materials:</b></p> <ul style="list-style-type: none"> <li>• Notebook</li> <li>• Projector</li> </ul> <p><b>Safety Notes:</b> NONE</p>
Vocabulary words: climate and weather	
<p><b>Lesson Objective(s):</b></p> <ul style="list-style-type: none"> <li>• Students will be able to identify the difference between climate and weather</li> </ul>	
<b>Today’s activities</b>	
<p><b>Description of activity:</b></p> <p><b>1. 5 minutes - Introduction</b></p> <p>a. Welcome students</p> <p>b. Ask for volunteers to share homework assignment. Ask for 2-3 volunteers. During, or between, shares ask students what they learned about their parents and their parents home environment through this assignment.</p> <p><b>2 minutes - KWL Chart</b></p> <p>a. Revisit the KWL chart. Share that they have a good start with the questions asked.</p> <p><b>5 minutes - What is climate?</b></p> <p>a. Ask students ‘what is climate’? To help them come up with answers, ask them to think about what they understand the weather to be and how it might be different than climate?</p> <p>b. As the students share answers, write them on the board.</p> <p><b>8 - minutes - Watch video &amp; Discussion</b></p> <p>a. <b>2-3 minutes</b> - Share with the students that they’ve shared very interesting points. Share that they will be watching a video to learn more about the difference between climate and weather. Video: <a href="https://www.youtube.com/watch?v=emPKer_pV14&amp;t=94s">https://www.youtube.com/watch?v=emPKer_pV14&amp;t=94s</a> or <a href="https://www.youtube.com/watch?v=CiZbF-gV2sQ">https://www.youtube.com/watch?v=CiZbF-gV2sQ</a></p> <p>b. Ask students to write down notes in their notebook</p> <p>b. <b>3 minutes</b> - After watching the video, ask the students to do a pair-share and with their partner come up with an answer regarding the difference between weather and climate.</p> <p>c. <b>2 minute</b> - Ask students to share their understanding of the difference and write it on the board.</p> <p><b>5 minute - Regroup</b></p>	

- |  |
|--|
| a. Ask students to share what they understand climate to be and the difference to weather.                                     |
| b. Once the students have finished sharing, share with them the difference between climate and weather, write it on the board. |

Parent Presentation: Parent shares a vivid memory of a weather-related event. Perhaps show a clip on the climate of their home region.

Homework

1. Complete an activity sheet where they review climate and weather; [first page](#) of this online workbook: <https://en.calameo.com/read/00058308482efb0619490>

Educative Resources

- To learn more about the difference between weather and climate, read through this helpful guide produced by NASA: [https://www.nasa.gov/mission\\_pages/noaa-n/climate/climate\\_weather.html](https://www.nasa.gov/mission_pages/noaa-n/climate/climate_weather.html)

Lesson 4: What is climate change?

<b>Subject/ Grade Level:</b> Earth Science - 4th grade	<b>Class Length:</b> 20 minutes
<b>Science Standards:</b> 4-ESS3-1 Earth and Human Activity: Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. 4-ESS3-2 Earth and Human Activity: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. 5-ESS3-1 Earth and Human Activity: Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment.	<b>Materials:</b> • Projector
	<b>Safety Notes:</b> NONE
Vocabulary words: climate change	
<b>Lesson Objective(s):</b> <ul style="list-style-type: none"> <li>• Students will know how to define climate change</li> </ul>	
<b>Today’s activities</b>	
<b>Description of activity:</b> <ol style="list-style-type: none"> <li><b>2 minutes - Introduction</b> <ol style="list-style-type: none"> <li>Welcome the students and ask students what they remember from class last week. Ask them about what they remember climate to be. Make sure to leave this conversation with a practical definition</li> <li>Afterward, ask students to read out the question of the day. Once a student volunteer has read the word, ask the students, “what is climate change?” Couple this question with, is climate change bad? Why is it bad?</li> </ol> </li> <li><b>8 minutes - Change of climate over time</b> <ol style="list-style-type: none"> <li>Introduce graph of climate over time. Ask students to look closely and identify any patterns that they see. Encourage students to look at the entire graph (left to right) and inform them of the years that they are looking at (2000 years). Inform them where you pulled this graph from.</li> <li>After a minute ask them to share what they noticed with their partner and have them come up with something to share with the group.</li> <li>Solicit 1-2 answers. After the students have shared that from the graph they can see that climate does change over time, but it is when climate changes rapidly that concerns many people.</li> </ol> </li> <li><b>5 minutes - Images of Earth ‘Dying’</b> <ol style="list-style-type: none"> <li>Transition into the next section by sharing images of popular renditions of climate change with students. As you share the pictures ask the students what they see and if they have heard of connections between what they and climate change. The point that you want to emphasize is that there are many ideas about what climate change, but climate change refers to change in the climate. The ideas that are being communicated through these pictures are supposed to show the consequences of the rapid change in climate, which we have seen recently.</li> </ol> </li> </ol>	

- b. Deconstruct some of these images, what their function is and the emotional pull they are meant to show.
- c. Conclude class with what they will learn next week.

Homework:

Climate versus Weather Worksheet

Resources

Climate data over time: <https://www.ncdc.noaa.gov/global-warming/last-2000-years>

Lesson 4: Homework

Name \_\_\_\_\_

Greenhouse Gas Worksheet

Instructions: Answer the following questions.

1. What radiation does the sun emit?
2. Solar radiation passes through the \_\_\_\_\_ of the Earth and reaches the surface of the Earth.
3. What atmospheric gases prevent heat from escaping?
4. This is because these gases (absorb / reflect / transmit) heat.
5. When solar radiation passes through something, this means that it is  
absorbed / reflected / transmitted
6. When solar radiation touches the surface of the Earth part of it is returned to space.  
This means that it has been: absorbed / reflected / transmitted
7. Part of the solar radiation that reaches the surface of the Earth is reflected  
back into space. This means that it has been absorbed / reflected / transmitted
8. What human activities have caused an increase in greenhouse gases?
9. What gas has increased due to humans? \_\_\_\_\_
10. How has the Earth's climate changed in the last 150 years?

Lesson 5: What are sources of greenhouse gases?

<b>Subject/ Grade Level:</b> Earth Science - 4th grade	<b>Class Length:</b> 25 minutes
<b>Standards:</b> Earth and Human Activity: Obtain and combine information to describe how energy and fuels are derived from natural resources and convert these resources into usable forms. Earth and Human Activity: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.	<b>Materials:</b> <ul style="list-style-type: none"> <li>• None</li> </ul>
	<b>Safety Notes:</b> NONE
Vocabulary: Greenhouse gases	
<b>Lesson Objective(s):</b> <ul style="list-style-type: none"> <li>• Students will identify sources of greenhouse gases</li> <li>• Students will be able to name a greenhouse gas</li> </ul>	
<b>Today's activities</b>	
<b>Description of activity:</b> <ol style="list-style-type: none"> <li><b>3 minutes - Introduction</b> <ol style="list-style-type: none"> <li>Welcome students and ask students to recall what they learned from last week. Try to weave in concepts learned in previous weeks: weather vs. climate; the changing of climate as a natural process; and greenhouse effect as natural and maintaining the earth warm.</li> <li>Ask a student to read the question of the day. Recognize that we have talked about the sources of greenhouse gases but today it will be covered more in depth.</li> </ol> </li> <li><b>8 minutes - Conceptualizing Greenhouse Gases</b> <ol style="list-style-type: none"> <li>Ask students to recall what greenhouse gases they learned in the previous week. Write on the board. Ask students what they remember the function that greenhouse gases are and write it down on the board.</li> <li>Ask students to explain how greenhouses work. Solicit a few responses and write these on the board. What should be coming together on the board is a concept map of related to greenhouse gases. Depending on the time, you might combine section b &amp; c.</li> <li>After students have shared their responses, briefly review what they students have shared about greenhouse gases.</li> <li>Pass out a copies of the diagram with a close up rendition of greenhouse gases in action. Communicate which are the greenhouse gases.</li> <li>Ask students to talk to their neighbor and describe what is going on in the image. After a minute ask the students to share what they see on the diagram.</li> <li>Once they have shared, communicate that in the diagram are greenhouse gases and that, although, it may seem like the gas traps the heat it doesn't. Watch brief clip on the how this operate: <a href="https://www.youtube.com/watch?v=G0wNsQm0ypA">https://www.youtube.com/watch?v=G0wNsQm0ypA</a>.</li> </ol> </li> <li><b>6 minutes - Review of Greenhouse Gases</b> <ol style="list-style-type: none"> <li>Share with students that, as seen in the videos and previous classes, there different greenhouse gases, such as: Water vapor (H<sub>2</sub>O) Carbon dioxide (CO<sub>2</sub>),</li> </ol> </li> </ol>	

Methane (CH<sub>4</sub>), Nitrous oxide (N<sub>2</sub>O), Ozone (O<sub>3</sub>). Some of these have been released a lot more in recent years [Carbon dioxide (CO<sub>2</sub>), Methane (CH<sub>4</sub>), Nitrous oxide (N<sub>2</sub>O)].

b. Show students diagram of temperature from the previous week and use it to make the connection of climate is changing because there have been more greenhouse gases (GHG) released into the atmosphere.

c. Share a copy of this [diagram](#) with students. Ask students to work with their partner to identify the biggest sources of GHG and to identify where it comes from. While they work with their partners share that this source comes from the EPA (an agency, or part, of the country whose mission is environmental protection).

d. Once they have talked to their partner, ask students what they came up with.

e. To conclude this section, highlight that climate is changing because there are more greenhouse gas emissions.

**3 minutes - Recapping**

a. Ask students to take a few minutes to write in their journal

- i. What do greenhouse gases do?
- i. What are examples of greenhouse gases?
- i. Where do are sources of greenhouse gases?

Resources

To learn more about greenhouse gases, check out these sites:

- <https://scied.ucar.edu/longcontent/greenhouse-effect>
- <https://ww2.kqed.org/quest/2014/12/12/what-are-greenhouse-gases-and-where-do-they-come-from/>
- <https://climate.nasa.gov/causes/>

Lesson 5: Homework

Name:

Directions: Put a 'W' next to the statement that best describes weather. Similarly, put a 'C' next to the statement that best describes climate.

The average weather in a location over multiple years	
Often reported as a forecast	
Short term measurement	
Determined by data collected for 30 years or more	
Often reported as averages	
Measurements recorded over a long period of time	
Ranges from a day to week	
70 degrees and partly cold	

Lesson 6: How does climate change?

<b>Subject/ Grade Level:</b> Earth Science - 4th grade	<b>Class Length:</b> 20 minutes
<b>Science Standards:</b> <ul style="list-style-type: none"> <li>• 4-ESS3-1 Earth and Human Activity: Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.</li> <li>• 4-ESS3-2 Earth and Human Activity: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.</li> <li>• 5-ESS3-1 Earth and Human Activity: Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment.</li> </ul>	<b>Materials:</b> <ul style="list-style-type: none"> <li>• Projector</li> </ul>
	<b>Safety Notes:</b> NONE
<b>Vocabulary words</b> <ul style="list-style-type: none"> <li>• Greenhouse effect, greenhouse gas</li> </ul>	
<b>Lesson Objective(s):</b> <ul style="list-style-type: none"> <li>• Students will be able to identify the process of greenhouse gas effect</li> </ul>	
<b>Today’s activities</b>	
<b>Description of activity:</b> <ol style="list-style-type: none"> <li>1. <b>3 minutes</b> - Introduction <ol style="list-style-type: none"> <li>a. Ask the students to recall some of the things they reviewed last week. As they share fill in gaps in their knowledge. Ideas that you want them to review: the difference between climate and weather; what is a change in the climate; and the function of popular images of climate change</li> <li>b. Ask a student to read the question of the day. Ask students to share what they think changes climate. Write it on the board. Share that last week they learned that climate has changed over time and this week they will learn how climate changes; share that towards the end you will make connections between what students wrote down and what they will learn today.</li> </ol> </li> </ol> <p><b>6 minute - Greenhouse Effect Video</b></p> <ol style="list-style-type: none"> <li>a. Before watching the video, create an extremely simplified image of the greenhouse gas effect. Points that you want to come across, what is the source of energy and there is a layer of gases that capture heat.</li> <li>b. Watch video. Pause occasionally to emphasizes points above</li> </ol> <p>i. Options for videos: <a href="https://www.youtube.com/watch?v=fYqdKiT0Ego">https://www.youtube.com/watch?v=fYqdKiT0Ego</a> ; <a href="https://www.youtube.com/watch?v=ZzCA60WnoMk">https://www.youtube.com/watch?v=ZzCA60WnoMk</a>; watch without sound</p> <ol style="list-style-type: none"> <li>c. Towards the end make sure to recognize that the greenhouse effect is a process that naturally occurred and is what has maintained the earth.</li> </ol> <p><b>5 minutes - Clarifying</b></p> <ol style="list-style-type: none"> <li>a. After watching the video, have a few students volunteer what they understood as maintaining the earth’s warmth. Solicit 3-4 responses and write them on the board. w</li> <li>b. Clarify any misunderstandings about the process.</li> </ol>	

c. Introduce vocabulary. The process that they have just learned about is: greenhouse effect. The gases that they saw were greenhouse gases. Emphasize that not all gases are greenhouse gases; emphasize that they are greenhouse gases because they contribute to the greenhouse effect. Other points that you want to emphasize: where the greenhouse gases exist.

**3 minutes - concluding**

a. Read the guiding question of the day and have 1-2 students contribute what they know about this.

Parent presentation:

- Story about their favorite thing about their childhood.

Resources

To learn more about the topic of greenhouse gases: <https://www.bbc.com/news/science-environment-24021772>

Lesson 7: What are climate actions?

<b>Subject/ Grade Level:</b> Earth Science - 4th grade	<b>Class Length:</b> 25 minutes
<b>Science Standards:</b> 4-ESS3-1 Earth and Human Activity: Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. 4-ESS3-2 Earth and Human Activity: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.	<b>Materials:</b> • None
	<b>Safety Notes:</b> NONE
Vocabulary: climate action	
<b>Lesson Objective(s):</b> • Students will identify actions they can take to directly impact climate change	
<b>Today's activities</b>	
<p><b>Description of activity:</b></p> <p>1. <b>3 minutes - Introduction</b></p> <p>a. Welcome and review the topics from last week: greenhouse gases and their sources</p> <p><b>7 minutes - Climate Action</b></p> <p>a. Present the diagram again of greenhouse gases. Have the students identify what are main contributors of greenhouse gases.</p> <p>b. Ask students to explain what these different sources of greenhouse gas sources: transportation, electricity &amp; heat, etc., might look like in their daily lives.</p> <p>c. Write down student answers, and ask students what they might do in order to reduce these sources of greenhouse gases connected to these contributors. This should look like a concept map.</p> <p>d. Make sure to emphasize while there are actions that are 'good' for the earth, there are some that are directly connected to climate change. Use the list on the second page to review the difference between environmentally friendly actions and actions that are directly linked to climate change.</p> <p>e. Have students come up with a list of climate actions. After they've listed several, point out which ones would have a more direct impact on climate.</p> <p><b>5 minutes - Identify personal climate action</b></p> <p>a. Ask students to use their journals to identify three actions they can do using the list created above.</p>	
<p>Parent presentation:</p> <ul style="list-style-type: none"> <li>• Ask parent to share some of their favorite climate actions. Talk to parent prior and identify actions that are directly related to climate and not simply environmentally friendly.</li> </ul>	
<p>Homework:</p> <p>Ask students to think of 5 climate action and come prepared to share the next week</p>	

Environmentally Friendly Actions	Climate Actions
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<ul style="list-style-type: none"><li>• Cleaning the beach</li><li>• Recycling</li><li>• Conserving water</li></ul>	<ul style="list-style-type: none"><li>• Planting vegetation</li><li>• Riding bike</li><li>• Eating less meat</li></ul>
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Lesson 8: Post-Course Evaluation

<b>Subject/ Grade Level:</b> Earth Science - 4th grade	<b>Class Length:</b> 20 minutes
<b>Science Standards:</b> 4-ESS3-1 Earth and Human Activity: Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. 4-ESS3-2 Earth and Human Activity: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.	<b>Materials:</b> <ul style="list-style-type: none"> <li>• Exam</li> </ul>
	<b>Safety Notes:</b> NONE
<b>Lesson Objective(s):</b> Students will be taking exam	
<b>Today's activities</b>	
<b>Description of activity:</b> <ol style="list-style-type: none"> <li>1. <b>4 minutes - Introduction</b> <ol style="list-style-type: none"> <li>a. Congratulate students for having participated in the course</li> </ol> </li> <li><b>15 minutes - Post-course exam</b> <ol style="list-style-type: none"> <li>a. Similar to the pre-course exam, have a student read instructions out loud and ask the class whether they understand the instructions. Remind them to write their name at the top and inform them that there is a backside to the evaluation. Students should be completing the entire evaluation and will have 15 minutes to complete it.</li> <li>b. Once students have started the evaluation, occasionally inform them about the time they have left.</li> </ol> </li> <li><b>1 minute - Conclude</b> <ol style="list-style-type: none"> <li>a. Collect exams from students and distribute homework. Thank students for participating in the course.</li> <li>b. Handout prizes, certificates, etc. if applicable</li> </ol> </li> </ol>	