

Sustainability Education in Elementary Schools:

Sustainability for Young Learners Courses

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Table of Contents

Abstract	3
Introduction	4
Sustainability within Public Schools.....	4
Sustainability for Young Learners Courses.....	6
Idea Conception	6
Supporting Research	7
Target Audience.....	8
Building the Project	8
Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis	10
Project Schedule – Work Breakout Schedule.....	11
Key Takeaways.....	14
Six Key Concepts to Create Successful Environmental Literacy Programs	14
Conclusion	17
References	18
Appendix A - Standards and Sustainability Topics per Grade Level	21
Appendix B - Work Breakout Schedule – Sustainability for Young Learners Courses	26
Appendix C - Third Grade Unit Plan – Ocean Plastics, The Problem and the Soution.....	27
Appendix D - Second Grade Unit Plan – Our Melting Oceans, Soild and Liquid Water.....	58

Abstract

Children are our future businesspeople, policy makers, and educators. As such, during their careers and throughout their life, they will be the leaders making tough decisions on how to respond to extreme heat phenomenon, rising sea levels, changing weather patterns, and the increased presence of greenhouse gases, which could thrust our Earth into irreversible change if emissions are not reduced drastically over the next few decades.

When evaluating the required Next Generation Science Standards for elementary school, these standards do not include environmental literacy or sustainability themes in either second, third, or fourth grades, with little mention via one standard in first, fifth, and sixth grades. Overall, the Next Generation Science Standards do not adequately prepare students for the sustainability problems of the future nor do the standards help connect students to the natural environment by not connecting the standards to real world climate issues. Not educating students about sustainability topics in elementary school passes the responsibility off to higher grades with optional science classes, where this sustainability education could be missed altogether. The Sustainability for Young Learners Courses were created to equip elementary school teachers with sustainability knowledge and resources to effectively teach sustainability to their students.

The Sustainability for Young Learners Courses infuse sustainability and environmental literacy into second through fifth grade science classes via the creation of detailed unit plans. Each course incorporates important sustainability themes into the required Next Generation Science Standards, to encourage teachers to adopt these unit plans without taking away limited class time to teach about sustainability. Rather than ending in doom and gloom, students finish each unit becoming the heroes of the story by creating their own solutions to combat climate change that they can implement into their own lives, communities, homes, and classroom.

Sustainability and climate related issues are already sweeping our Earth and the problem is likely going to accelerate as today's current elementary school students start their professional careers. Equipping young students with environmental literacy and sustainability knowledge can allow students to be ready to face real-world climate related issues in the future as well as today as these students serve as leaders within their communities and schools. By realizing the gap in the United States education system, the Sustainability for Young Learners courses is helping to create a more equitable, prosperous, and sustainable society through education and knowledge.

Introduction

Sustainability is a three-legged stool, containing three pillars needed for success. The three sustainability pillars are environment, social, and economic (UN General Assembly, 2015). The environmental pillar represents an understanding that in order for the human species to sustain ourselves, we must protect our environmental resources and natural spaces for future use and enjoyment. This pillar is similar to the “leave no trace” trail moto, where humans strive to leave as small of a trace as possible on our natural environment, in order for future generations to utilize, enjoy, and prosper alongside the natural environment. The second pillar represents the social side of sustainability, which firstly ensures that all basic human needs are met and secondly provides equitable, fair, and safe opportunities for people of all backgrounds and cultures. The third pillar of sustainability is the economic side of sustainability. This warrants that all individuals will be economically able to meet their daily needs while businesses and governments are able to continuously operate within the other two pillars.

Sustainability leadership melds traditional leadership ideologies with the three pillars of sustainability to create leaders that are equipped with the skills needed to make decisions today with future-thinking in mind (Gallagher, 2012). As with any leader, sustainability leaders do not need a title to create change, and they can appear at any part of the organization or community. Sustainability leaders are individuals that understand the three pillars of sustainability and take science-based climate science into consideration when making decisions, actions, and progress towards creating a more equitable, healthy, and sustainable future.

Sustainability within Public Schools

Sustainability leadership is a relatively new field, only emerging as university majors over the past two decades. However, some companies have been following sustainability goals and values for over two decades, including arguably one of the best for-profit business in the sustainability game, Patagonia and others taking the field by storm including Unilever and Interface (Coulter & Lee, 2013). Despite the surge of businesses releasing sustainability reports and universities winning sustainability awards, the sustainability movement has not made its way into the K-12 public schools throughout the United States. Most students in the United States are required to be taught a multitude of standards for each subject, including the Common Core standards for Math and English Language Arts, which includes History, along with the Next Generation Science Standards for science (Common Core State Standards Initiative, 2019) (Next

Generation Science Standards, 2019). Additionally, each state also has standards released by that state's Department of Education, which can include additional subjects and standards. For example, Colorado has standards in Science, Music, Physical Education, Computer Science, and Reading, Writing and Communication that schools within Colorado must teach to their students in addition to the Common Core and Next Generation Science Standards (Colorado Department of Education, 2019). With schools required to teach so many different standards, teachers do not have class time to teach subjects or topics outside of those described within the required standards.

Schools are designed to educate and prepare students for the future. But schools are failing to educate students for a life in a world with more extreme heat phenomenon, rising sea levels, changing weather patterns, and the increased presence of greenhouse gases, which could thrust our earth into irreversible change if emissions are not reduced drastically over the next few decades (NASA, 2019). The required elementary Next Generation Science Standards only educate about sustainability themes in kindergarten, fifth, and sixth grade, with just one sustainability or environmental literacy related standard in fifth grade (Next Generation Science Standards, 2019). Environmental literacy is when students are literate in environmental topics, including, having “knowledge about the environment, attitudes toward the environment, and environmental behavior” (Tal & Peled, 2017). Failing to educate students in elementary school about sustainability or environmental literacy causes three problems. First it puts this education onto parents' shoulders, some of whom might not care about the issue or whom might deny it altogether. Secondly, the standards do not adequately prepare students for the future nor does it help connect students to the natural environment by not connecting the standards to real world issues (Chambers, 2007). By connecting the standards to real world issues, such as sustainability topics, students are more engaged and, “find the content more interesting” (Stratton, Hagevik, Feldman & Bloom, 2015). Lastly, not educating students about sustainability topics in elementary school passes the responsibility of education off to higher grades with optional science classes. Without allowing students to grow their environmental literacy within each grade, students are not able to reinforce their understanding of environmental literacy, which reduces long term knowledge obtainment (Villasmil, 2018).

Sustainability education is not just lacking in the United States; countries such as Australia, Canada, and Israel only have optional sustainability standards that are not very present

throughout classrooms across the country (Tal & Peled, 2017) (Fernandes, 2012). The UNESCO Education Sector also states that, “while many nations around the world have embraced the need for education to build capacity to achieve sustainability, only limited progress has been made on any level” (UNESCO Education Sector, 2005). Additionally, “a lack of vision or awareness of the role education could play in achieving sustainability has impeded progress” in both developing and developed countries throughout the world (UNESCO Education Sector, 2005).

With the lack of sustainability education and resources for teachers in the United States, many organizations and school districts are creating environmental literacy programs. Various environmental literacy programs include district run environmental literacy websites, which often feature a resources page where teachers can download resources around environmental and sustainability themes. The San Mateo County Office of Education has an Environmental Literacy Program, which offers various environmental literacy trainings along with pre-made environmental literacy lesson plans for district teachers (San Mateo County Office of Education: Environmental Literacy and Sustainability Initiative, 2019). Additionally, certain cities are also seeing the importance of environmental education and are creating their own sustainability educational programs that focus specifically on the city’s sustainability goals. The Town of Gilbert, Arizona has a School Outreach and Education program where city staff go into Gilbert Elementary schools to teach about sustainability themes related to their city (Lund, 2019c).

Sustainability for Young Learners Courses

Idea Conception

The idea for the Sustainability for Young Learners Courses was sparked by curiosity of when and how students are learning about sustainability. Growing up, my family participated in many environmentally friendly practices such as recycling, composting, and reusing resources. However, my first formal introduction into sustainability and environmental literacy took place during my first term of college, where I opted into a year-long environmentally themed English class called “Green House” through Southern Oregon University. Realizing that the first time I had learned about sustainability in the classroom was during my undergraduate studies left me curious if science standards in K-12 had changed to incorporate real-world climate related issues. After conducting research and learning that second, third, and fourth grade Next Generation Science Standards did not mention any sustainability themes, and only one standard mentioned sustainability in fifth grade, the Sustainability for Young Learners Courses were developed (Next

Generation Science Standards, 2019). By connecting the required science standards to sustainability themes, this project allows students to learn about the importance of sustainability and how humans are negatively impacting our world, without taking away class time from learning about the required standards. Students also learn and discover ways in which they can change their behaviors to be more environmentally conscious.

Supporting Research

Colorado State University professors Camacho and Legare argue that teachers should be responsible for helping to provide student with the skills needed to “live sustainable lifestyles, help students develop knowledge, values, skills, and a worldview that may lead to sustainable patterns for living” (Camacho & Legare, 2018). The researchers found that partnerships between a school district and outside entities can allow the school district to create goals and outcomes for this sustainability education. Camacho and Legare also researched a similar project within the Town of Gilbert, Arizona who had partnered with the city’s public-school district (Town of Gilbert, Arizona, 2019). The Town of Gilbert’s Outreach Coordinator goes into classrooms, “to provide environmental education programs for K–6 students, such as a ‘What is your ecological footprint’ assignment and a pollution index exercise” (Camacho & Legare, 2018). Additionally, Bestelmeyer et al. research noted that students became more environmentally aware when the environmental education reading within their textbooks were reinforced through in-class projects (Bestelmeyer, et al., 2015). Research by Chambers, who studied elementary school ecological literacy materials utilization, found that classroom experiences and texts, “have the power to shape knowledge construction, student identity and an environmental consciousness” (Chambers, 2017). Therefore, each of the Sustainability for Young Learners Courses includes a hands-on activity or an experiment designed to reinforce the lesson’s learning outcomes.

Another research project took place in the United Kingdom (UK) in 2005 at schools that had already committed to environmental education. The study interviewed students within 15 UK schools over the course of three years, who had attended schools that were committed to teaching and integrating sustainability into their classrooms and curriculum (Gayford, 2009). Gayford found that over the three-year study period, “there were improvements both in pupils’ knowledge of issues related to sustainability and their relevant abilities and competencies” (Gayford, 2009). Additionally, the study found that innovative teaching approaches which

involved the students were much more well received than lecture style classes (Gayford, 2009). Each unit of the Sustainability for Young Learners Courses includes class discussions, videos, articles, photos, a final project, and a hands-on experiment that engage the students more than simply conducting a lecture style class.

Target Audience

An emphasis on elementary school students was decided upon for two main reasons. The first is that through Gayford's study in the UK, the study found that "pupils in the primary schools have generally shown more enthusiasm for all aspects of learning for sustainability than most pupils in the secondary schools" (Gayford, 2009). Additionally, an energy study conducted by Craig and Allen found that younger people tend to value sustainability and environmentally friendly practices at a greater level than their parents do (Craig & Allen, 2014). In a different study about elementary curriculum learning around energy consumption, Craig and Allen found that educating students about energy consumption during school lead to, "a decrease in energy consumption of more than 15% in student homes and more than 30% at the local school" (Craig & Allen, 2015). This study also showed that students were able to take the environmental literacy knowledge that they learned inside the classroom and have discussions about this knowledge with their parents at home (Craig & Allen, 2015). Considering this, it was decided to focus the efforts for these classes on second through fifth grades. First grade was omitted from the project due to the student's cognitive level.

Building the Project

There are many resources available that provide teachers with a short lesson plan on various sustainability topics. However, due to the magnitude of standards that teachers are required to teach, there is little time to include other materials outside of the required standards. Therefore, each of the units needed to incorporate sustainability themes into the required Next Generation Science Standards. Going into the project, there were certain topics that were identified that would be taught per grade level. However, after reviewing the required standards per grade level, the original topics needed to be modified to meet the required standards. Each grade's unit plan has main standards, secondary standards, and sustainability topics clearly outlined to show how the standards connect to the sustainability topic presented (See Appendix

A). Additionally, all three pillars of sustainability, including environmental, social, and economic, were covered in each of the unit plans to ensure that a holistic viewpoint of sustainability was presented in each unit plan (UNESCO Education Sector, 2005).

The project conception and initial project proposal was intended to be primarily utilized by the Sustainability Department at Denver Public Schools (DPS) and by DPS teachers. The project would meet the goals of DPS and help teach their students about the most pressing sustainability topics that DPS identified. During the initial creation of the unit plans, it was identified that these unit plans would also be applicable to elementary teachers across the United States. This is because either the Next Generation Science Standards or the framework for K-12 Science Education is taught within 44 states and represents “71% of U.S. students” (National Science Teaching Association, 2019). A focus still remained on having the units meet the sustainability goals of DPS, by including themes on composting and energy reduction solutions. However, a broader audience was kept in mind when planning the activities and students’ worksheets to ensure that teachers across the county could seamlessly integrate these lesson plans into their classrooms. With the focus turning to the national stage, the Teachers Pay Teachers website was identified as the best way to get these lesson plans into the hands of teachers across the United States. The Teachers Pay Teachers website offers lesson plans and activities for every subject and grade level, some of which are free and others which cost money. In 2018, over five million teachers visited and used the site (Teachers Pay Teachers, 2019). The site has over three million resources that have been downloaded over a billion times (Teachers Pay Teachers, 2019). With the wide reach of teachers searching for lesson plans on this website, it was decided that posting each of the unit plans and PowerPoints for free onto the Teachers Pay Teachers website would greatly increase the reach of the program.

After the lesson plans were completed, it was decided to conduct a pilot project, where each of the unit plans would be taught in a DPS classroom by the content creator. The goal was to teach each of the unit plans, which comprises of five different lessons, at least once in second through fifth grades. However, due to the timeframe of the project and the logistics needed to teach five, 45-minute classes per grade, it was decided that there would not be a pilot period for this project, in order to complete the project within the desired timeframe.

Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis

A SWOT Analysis has been conducted to show the Strengths, Weaknesses, Opportunities, and Threats of the project from the initial project idea to project completion.

Strength - A strength of this project is that all of the sustainability themed unit plans directly teaches either one or two of the Next Generation Science Standards. Therefore, teaching these unit plans does not take class time away from teaching the required standards, which could increase the adoption and utilization rate of these unit plans compared to if the unit plans did not teach the standards. Another strength is that each of the unit plans includes detailed descriptions of each lesson, a fully created PowerPoint, a student worksheet for each lesson, and an interactive activity or experiment which includes photos of each step of the experiment. Therefore, the lesson plans do not require any additional prep time from the teacher aside from having the materials ready for the lesson and printing out the student handouts. The last strength of this project is that all of the unit plans includes writing activities, with some of the units plans having literacy standards as connection standards. Bringing in writing components into science classes allows students to have a stronger sense of the topic and to utilize their writing skills outside of the typical Language Arts setting (Rogers & Abell, 2013).

Weakness - One of the weaknesses of the project is that the content creator does not have a teaching credential. Therefore, teachers might not trust or utilize the teaching materials since the content creator is not a certified teacher. To make up for this weakness, the lesson plans have all been reviewed by three teachers that currently teach in elementary schools in the United States. Another weakness of the project is that the teachers searching for sustainability and environmental literacy unit plans might already be teachers that either incorporate some sustainability practices into their lives or who might informally teach about sustainability themes in their classrooms. Teachers who do not see climate change or sustainability as important likely will not search for or utilize sustainability unit plans.

Opportunity - An opportunity for the Sustainability for Young Learners Courses is to connect, network, and create partnerships with other Environmental Literacy programs, such as those run by non-profits, cities, or Environmental Literacy Offices housed within a school district. Most of these organization's websites features a teacher resource page, where teachers can browse through curated environmental literacy resources. There has been communication between two organizations that would be interested in seeing the completed unit lesson plans and

would consider putting these unit lesson plans on their website. The opportunity would be to reach out to more environmental literacy organizations for their consideration of adding the unit plans onto their website. Another opportunity would be to create an informational printout or a sustainability board game that would be sent home with the students following the lesson plans. The informational printout would be a graphics heavy printout that would inform parents about the sustainability themes taught within the class. A sustainability board game could include sustainability themed tasks that students would complete at home with their parents. Once completed, the student could take it back to their teacher for a homework pass or other small classroom prize.

Threat – The threat to the project turned out to be the timeline regarding teaching these unit plans within DPS schools. Considering logistics and time needed to teach these unit plans within DPS classrooms in conjunction with the project timeline and outbreak of COVID-19, it was decided not to teach these unit plans within a DPS classroom. Therefore, the threat to this project is that the lesson plans have not yet been tested to see how students respond to the activities and to understand if the flow of the classes are well received by teachers and students alike.

Project Schedule – Work Breakout Schedule

The timeline for completing the Sustainability for Young Learners Courses project took place over the course of nine months, from the initial project idea until the completion of the project closeout documents. There were four phases of the project, which have been displayed within the Work Breakout Schedule (See Appendix B). This section of the paper provides an overview of the project schedule and an accompanied Work Breakout Schedule (See Appendix B). The Work Breakout Schedule is provided in order to aid other sustainability leaders through the creation of a similar project (See Appendix B).

Phase one of the project is titled Partnerships (See Appendix B). This phase has two parts, which includes setting up the partnerships and gathering the necessary goals and expected outcomes from the partners. Setting up the partnerships is the first part of the project, which was completed within the first month. Online research was conducted in order to find several viable partners to reach out to see which organization would like to partner on this project. During this preliminary research, the organization's mission, sustainability goals, and context to the local community were considered. At the beginning of the project, the Sustainability Department for

the City and County of Denver, Denver Waste Management, and the Sustainability Department at Denver Public Schools were identified as possible organizations to partner with. After identifying possible organizations to partner with, it was identified how the organization's goals could be achieved through partnership. All three partners were contacted regarding possible interest in partnership. After communications with the partners, it was determined that DPS's Sustainability Department was most interested in partnering on this project.

Once DPS's Sustainability Department agreed to partner on this project, a meeting was set up with the project lead and the representative from DPS. Prior to the meeting, the intention for the Sustainability for Young Learners Courses was to create one, 45-minute lesson plan for first through fourth grades which covered a certain sustainability topic. After meeting with DPS, it was decided that the project would create a week-long unit that incorporated a specific sustainability theme into the already required Next Generation Science Standards (Lund, 2019a). This meeting took place at the beginning of the second month of the project. After the meeting, the goals of the project were identified, and a rough project schedule was laid out.

Phase two of the project included creating the project deliverables and receiving feedback on the deliverables from teachers and project partners. This part of the project took roughly three to four months. The deliverables for this project included creating the unit plans, PowerPoint, and the student worksheets for second, third, fourth, and fifth grades. Since elementary school teachers are not trained in sustainability topics during their teaching certificate, the use of articles and on-topic videos made for kids were heavily utilized throughout each of the lessons per unit (Stratton, Hagevik, Feldman, & Bloom, 2015). Including these detailed videos explaining complex issues such as composting and sea level rise that were age appropriate, takes away the stress and extra prep time required for the teacher to understand these topics at a level where they feel comfortable explaining to their students. A PowerPoint presentation was created for each unit plan. Each PowerPoint included the unit's vocabulary words with photos for each word, links to the unit's videos for easy access, and created a visual layout that allows teachers to easily follow along with each activity and lesson within the unit plan.

Once the videos and articles were identified, all the information needed to be compiled together. First, a brief layout was created for each grade level, which included a brief description of the activities per lesson along with videos and other materials. These draft unit plans were completed during the third month of the project and were sent to the DPS Sustainability

Department for review and feedback. DPS recommended that the units include more detailed description of each activity, while teachers who looked over the drafts recommended that students needed to complete a worksheet or deliverable for each lesson. Utilizing the feedback, month four and five of the project were dedicated to adding in more detailed explanations and time recommendations into each lesson and included a student deliverable per class. For example, in the third-grade unit plan within Lesson #2 titled, “How Global Warming is Heating up our Earth”, featured a 35-minute ice cube experiment (See Appendix C). After receiving feedback from DPS, this activity was broken down into three subparts, each with time intervals to keep the lesson organized and to help the teacher keep time. After completing each grade level’s unit plan, the unit plans were sent to an elementary school teacher who reviewed the unit plans. Once all of the grade’s unit plans were completed, all of the unit plans were sent to DPS’s Sustainability Department for a final review, which brought the project into the beginning of the sixth month.

Phase three of the project includes deliverable modifications and sharing of the unit plans, which took place during the sixth, seventh, and eight months of the project. This included taking the previous unit plans that were created in Word and redesigning all of the four-unit plans to have a professional look and layout via the design website Canva. Additionally, the lesson plans were sent to 40 environmental literacy organizations, including district ran Environmental Literacy programs, such as the San Mateo County Office of Education along with other environmental education organizations, such as the North American Association for Environmental Education. Each of the unit plans were also posted free of charge onto the Teachers Pay Teachers website in order to spread the reach of the program to a wider audience. Lastly, the content creator created a website in which to host these unit plans permanently.

The last phase of the project is phase four, which is the project evaluation phase. This part of the project took place during the ninth and final month of the project. During this phase, feedback was collected from teachers and partners, in order to gauge the effectiveness of the Sustainability for Young Learners Courses. Feedback was collected off of the Teachers Pay Teachers website, after teachers downloaded and taught the unit plans. Once the feedback was collected, the project was evaluated, and a project closeout document were created.

Key Takeaways

Six Key Concepts to Create Successful Environmental Literacy Programs

Environmental literacy programs for kids can range from after school garden classes, to stand-alone classes offered by a city, to in-class learning opportunities such as the Sustainability for Young Learners Courses. Whether a program is designed for one local school, or focuses on one topic to many sustainability topics, there are six key concepts that can help create a successful environmental literacy program.

One – Include place-based learning into each unit. Create a program that is regionally specific, yet nationally scalable. Programs that are specific to a location allows students to participate in location-based, or place-based learning, which is learning designed to incorporate students' surroundings and regional issues into the classroom (UNESCO Education Sector, 2005). By focusing on regional, location-based learning, students can become active young citizens who are more engaged in the learning process (Chambers, 2007). By incorporating location-based learning that focuses on the student's local community, student's feel more compelled to implement solutions because the learnings were directly related back to the student's physical community and cultural context (UNESCO Education Sector, 2005). However, by highlighting regional topics while keeping scalability in mind, sustainability content designers can reach more students and classrooms to increase the program's reach. For example, the third-grade unit plan contains a worksheet titled "How rivers and streams connect to the ocean", which is an activity that can connect students from all over the United States to the ocean plastic pollution problem (See Appendix 3). This is done by having students identify where they live within the map provided and draw the route from their home to the ocean or large lakes via the rivers outlined in the map. Students then write a short description regarding how plastics thrown in a river near in the student's community could end up in the ocean through interconnected streams and rivers across the United States. This activity allows land locked teachers the ability to show their students how ocean plastic problems relates to their community, even if the students do not have direct access to the ocean.

Two – Incorporate the required standards and curriculum. When creating environmental literacy programs, it is important to incorporate the required curriculum or standards into any environmental literacy program. In the United States, teachers from 44 states must follow the Next Generation Science Standards or the framework for K-12 Science Education (National

Science Teaching Association, 2019). Due to the number of standards, teachers have little room to teach any additional information. In an interview that Chambers conducted with elementary school teachers, “It was expressed that if teachers could not immediately see the curricular links, they would not use the resources” (Chambers, 2007). Research from Chambers shows that environmental literacy programs which focused on teaching a certain sustainability topic and not focusing on the required standards were not widely used by teachers. The Sustainability for Young Learners Courses infuses sustainability themes into the existing required Next Generation Science Standards via week-long, unit plans. Each unit plan covers one to two main science standards, followed by a few connecting standards, which are either science or literacy standards (See Appendix A).

Three - Utilize subject matter experts. The optimal team for creating an environmental literacy program includes both sustainability professionals and teachers (Tal & Peled, 2017). Bringing in teaching subject matter experts, such as teachers, principals or curriculum experts, either as part of the project team or as a reviewer, can elevate a project (Tal & Peled, 2017). A sustainability leader’s job in this program will be to incorporate sustainability themes into the lesson plan in a grade appropriate manner that relies heavily on science-based findings. Teachers and principals will assist in providing guidance and feedback regarding the lessons and programs to make sure that they are viable for real world classrooms, student clubs, and after school events (Lund 2019b) (Lund 2019d). Since most sustainability professionals are not teachers, having teachers’ input will ensure that the lessons are grade appropriate, that the materials meet the standards included, and that the timing of the lesson is realistic for the grade level.

Four - Never end with doom and gloom, make the students the heroes through solutions. Facts about climate change can be overwhelming for many adults to face, and children are no exception. By simply stating the facts about climate change without offering solutions, students can leave feeling hopeless and frustrated, or not knowing how to utilize the knowledge that they just obtained within their daily life. When facts are coupled with solutions that the student can implement, the student can take the newly gained knowledge about climate change and use the solutions to act on the problems that they are learning about (Elfin & Sheaffer, 2006). This can also allow students to practice using solutions thinking and problem-solving techniques during class and apply these solutions to their real life. Students are able to engage in small actions themselves every day, such as composting or recycling at school, bringing a reusable water bottle

to school, or walking to school. Allowing students to come up with their own solutions shows the students that they can help to make a difference, because when more students are involved in sustainability, they can create a more sustainable school and community (Colbert, 2018). In addition to small solutions, allow the students to be the heroes of the story by having them personally come up with solutions to the problems presented (Lund, 2019e). This will allow the students to propose solutions that they think they can implement and will also engage the students by making them the superhero of the story. By making the students feel a part of the story and the lessons, the student will feel more engaged and ready to take action.

Five – Consider different learning styles. Every student learns differently, therefore what engages and connects to some students might not engage or be completely understood by other students (Jones, 1996). Students can have one of the seven, or a combination of learning styles, including spatial, linguistic, auditory-musical, mathematical, intrapersonal, interpersonal and kinesthetic (Jones, 1996). When designing environmental literacy content, it is imperative to keep in mind these seven learning styles and create activities that will engage all types of learners. Using hands-on activities, experiments, videos, photos, and text within the same lesson or unit can help engage and activate all student's minds throughout each lesson. Each of the units within the Sustainability for Young Learners Courses includes writing and reading activities, videos and PowerPoints with photos, and experiments to engage all types of learners. Key concept number three, which is to utilize subject matter experts, can be utilized to receive feedback from teachers on whether or not the program or unit plans includes a diverse array of activities that will engage all of the seven intelligence and learning styles.

Six – Provide additional resources for the teachers. Teachers are subject matter experts in their field; however, they might not be experts in sustainability or environmental topics. Stratton and Feldman conducted a study on teachers' knowledge of sustainability before and after the teachers underwent a sustainability training. Before the training, the teachers described their level of sustainability knowledge as "simply encompassing environmentally-friendly practices such as recycling and composting, not fully considering its multidimensional nature and its relevance to environment, economic, and sociocultural issues" (Stratton, Hagevik, Feldman, & Bloom, 2015). If an environmental literacy program or lessons will be taught by teachers, make sure to include a reference section for teachers to gain a more in-depth understanding of the topic. The San Mateo County Office of Education's Environmental Literacy

Program created pre-made lesson plans that includes additional resources geared at the teacher, whereas the resources in the lessons are geared at the student's grade level (San Mateo County Office of Education: Environmental Literacy and Sustainability Initiative, 2019). Providing these resources will allow teachers to gain more sustainability knowledge and will act as reference in the event that teachers might doubt why certain themes are taught within the classroom. Each of the unit plans within the Sustainability for Young Learners Courses includes a section titled Teacher Resources, which is a curated resource list featuring videos and articles that are directly related to the teachings of that particular unit plan (See the "Teacher Resources" section within Appendix C and Appendix D).

Conclusion

With children being the next scientists, policy makers, businesspeople, and decision makers of the future, it is imperative to educate students about science-based sustainability themes from an early age within elementary school. Even though the Next Generation Science Standards do not cover sustainability themes in second, third, and fourth grade does not mean that sustainability cannot be taught within elementary school classrooms (Next Generation Science Standards, 2019). By infusing important sustainability themes into the Next Generation Science standards, teachers are able to meet the required science standards while providing their students with real world climate knowledge and solutions that students can implement into their daily lives at school, at home, and within their community.

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Appendix A

Standards and Sustainability Topics per Grade Level

Figure A1

Second Grade Standards and Sustainability Topic	
Main Standards	<p>2-ESS2-3: Obtain information to identify where water is found on Earth and that it can be solid or liquid. (Next Generation Science Standards, 2019)</p> <p>K-2-ETS1-1: Engineering Design - Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool. (Next Generation Science Standards, 2019)</p>
Secondary Standards	<p>2-ESS2-1 Earth’s Systems - Connections to the Nature of Science, Crosscutting Concepts: Science addresses questions about the natural and material world. Scientists study the natural and material world. (Next Generation Science Standards, 2019)</p> <p>2-ESS2-1 Crosscutting Concepts - Connection to Engineering, Technology, and Application of Science: Developing and using technology has impacts on the natural world. (Next Generation Science Standards, 2019)</p> <p>Colorado Academic Standards: Second Grade, Standard 1: Physical Science. Grade Level Expectations: Matter exists as different substances that have observable different properties. (Next Generation Science Standards, 2019)</p>
Sustainability Topic	<p>Students will describe that there is both solid and liquid water in the ocean and that ocean ice is melting faster due to climate change. Students will identify and learn about different solutions to mitigate climate change. Students will learn what composting is, why it is important, and how to compost.</p>

Figure A2

Third Grade Standards and Sustainability Topic	
Main Standards	<p>LS2.C: Ecosystem Dynamics, Functioning, and Resilience - When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die. (Next Generation Science Standards, 2019)</p> <p>3-LS4-4: Biological Evolution: Unity and Diversity - Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change. [Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.] [Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.] (Next Generation Science Standards, 2019)</p>
Secondary Standards	<p>RI.3.1: Literacy Common Core State Standards Connection: Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-LS4-1), (3-LS4-2), (3-LS4-3). (Next Generation Science Standards, 2019)</p>
Sustainability Topic	<p>Our oceans are changing, and it is predicted that by 2050 there will be more plastic in the ocean than fish. Students learn about the physical changes of increased plastic pollution into the ocean and how that is affecting ocean life. Student learn about and come up with several solutions to mitigate the problem.</p>

Figure A3

Fourth Grade Standards and Sustainability Topic	
Main Standards	<p>4-ESS3-1: Earth and Human Activity - Obtain and combine information to describe that energy and fuels are derived from natural resources and that their uses affect the environment. [Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels.] (Next Generation Science Standards, 2019)</p> <p>SS3.A (4-ESS3-1): Disciplinary Core Ideas: Natural Resources - Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. (Next Generation Science Standards, 2019)</p>
Secondary Standards	<p>4-ESS3-2: Constructing Explanations and Designing Solutions - Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (Next Generation Science Standards, 2019)</p> <p>Literacy Common Core Standards Connections: RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-ESS3-2). (Next Generation Science Standards, 2019)</p>
Sustainability Topic	<p>Students will learn that energy can either come from a renewable or nonrenewable source and learn about the effects of burning fossil fuels has on our planet. Students learn about potential solutions to not burning and reducing their use of fossil fuels.</p>

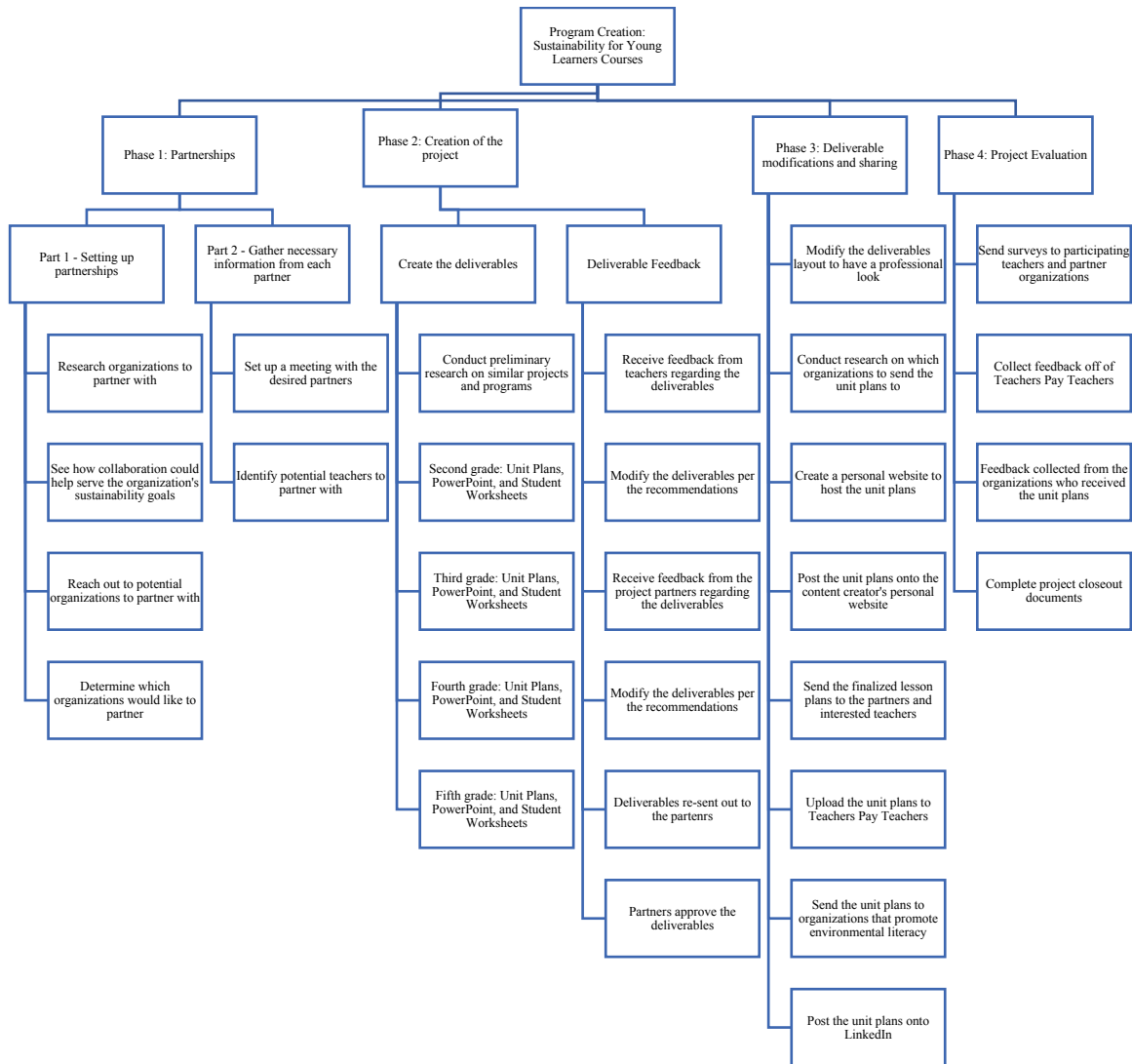
Figure A4

Fifth Grade Standards and Sustainability Topic	
Main Standards	<p>5-ESS3-1: Human Impacts on Earth Systems: Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth’s resources and environments. (Next Generation Science Standards, 2019)</p> <p>5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment. (Next Generation Science Standards, 2019)</p>
Secondary Standards	<p>RI.5.9 Literacy Connection – Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS3-1). (Next Generation Science Standards, 2019)</p> <p>W.5.8 Literacy Connection – Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS3-1). (Next Generation Science Standards, 2019)</p> <p>5-LS2-1 Science Connection – The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as “decomposers.” Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. (Next Generation Science Standards, 2019)</p>

Sustainability Topic	Students will learn about various environmental problems and how these problems are impacting our world. Students will focus on the problems related to food waste and sending food to the landfill. Students will learn about backyard and industrial composting as a solution.
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Appendix B

Figure B1: Work Breakout Schedule – Sustainability for Young Learners Courses



Appendix C

Third Grade Unit Plan - Ocean Plastics, The Problem and the Solution

OCEAN PLASTIC – THE PROBLEM & THE SOLUTION

THIRD GRADE SUSTAINABILITY THEMED UNIT PLAN



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INTRODUCTION**TABLE OF CONTENTS****Introduction**

Standards	1
Desired Results	2
Materials Needed	3

Lesson Plans and Teacher Resources

Lesson #1: Vocabulary words and single-use plastics	4
Lesson #2: Ocean plastics are a big problem	6
Lesson #3: Ocean pollution experiment	8
Lesson #4: Solutions to the plastics problem	11
Lesson #5: Solutions, Presentations, and Class Pledge	13
Teacher Resources	15

Student Worksheets

Single Use Plastics – Identification and Alternatives	17
How rivers and streams connect to the ocean	18
The 5 R's to Waste - I can Refuse, Reduce, Reuse, Repair, and Recycle	19
Ocean Plastic – The Problem and the Solution	20
Class Pledge	22

Additional Information

Newsela Article	23
Objects to print	25

INTRODUCTION

STANDARDS**MAIN STANDARDS**

LS2.C: Ecosystem Dynamics, Functioning, and Resilience - When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die.

3-LS4-4: Biological Evolution: Unity and Diversity - Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change. [Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.] [Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.]

STANDARD CONNECTIONS

RI.3.1: Literacy Common Core State Standards Connection: Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-LS4-1), (3-LS4-2), (3-LS4-3)

INTRODUCTION

DESIRED RESULTS**OBJECTIVE**

Our oceans are changing, and it is predicted that by 2050, there will be more plastic in the ocean than fish. Students learn about the physical changes of increased plastic pollution into the ocean and how that is affecting ocean life. Students learn about and come up with several solutions to mitigate the problem.

ESSENTIAL QUESTIONS

1. How are our oceans changing?
2. Why is there plastic in our oceans?
3. How does ocean plastic affect marine animals and humans?

FACTUAL KNOWLEDGE

Students will learn:

1. That the ocean ecosystems are changing and that is because of the plastic pollution problem.
2. About the Great Pacific garbage patch.
3. That there are five gyres collecting trash all throughout the world.

PROCEDURAL KNOWLEDGE

Students will be able to:

1. Properly recycle and compost within their own city and county.
2. Physically see ocean pollution (trash and oil) within an experiment and see how hard it is to clean it up.
3. Come up with several solutions that the student can implement to help solve this problem.

CONCEPTUAL KNOWLEDGE

Students will understand:

1. Many different solutions that can be implemented to prevent or clean up ocean pollution.

PERFORMANCE TASK

Students will work individually on a handout where they will show:

- The plastics problem in our ocean.
- How ocean plastic pollution is affecting plants and animals.
- Potential solutions to the problem.

INTRODUCTION

MATERIALS NEEDED

Material	Lesson and Activity
Single Use Plastics – Identification and Alternatives – Student Worksheet <ul style="list-style-type: none"> • One copy per student 	Lesson 1, Activity 2.2
Reading - <i>Tons of Trash in the Ocean Hurt Animals</i> <ul style="list-style-type: none"> • Students can read this on laptops, the article can be printed out, or students can read the article projected on the whiteboard 	Lesson 2, Activity 2.1
How rivers and streams connect to the ocean: Student Worksheet <ul style="list-style-type: none"> • One copy per student 	Lesson 2, Activity 3.2
Ocean Pollution Experiment <ul style="list-style-type: none"> • One large clear plastic tub or large clear bucket • 3 mason jars with lids • For the “pollution” part of the experiment: <ul style="list-style-type: none"> ○ Cooking oil: 3-5 tablespoons ○ Balsamic oil or cocoa powder (for brown color): 3-5 tablespoons ○ Used coffee grounds or dirt – 1-2 cups • For the trash - any type of plastic trash that is available, including: plastic bags, chip bags, plastic to-go containers, plastic bottles and bottle caps, etc. • For cleaning up the pollution: <ul style="list-style-type: none"> ○ Coffee strainer ○ Sponges ○ Cotton balls ○ Net – if available ○ Tongs 	Lesson 3, Activity 1-2
Ocean Plastic – The Problem and the Solution: Student Worksheet <ul style="list-style-type: none"> • One copy per student 	Front side: Lesson 3, Activity 2.1 Back side: Lesson 5, Activity 1
Sorting Hands on Demo <ol style="list-style-type: none"> 1. Print out the photos in the attached document titled, “Objects to print out for the sorting activity” 2. Bin labeled “compost” 3. Bin labeled “trash” 4. Bin labeled “recycling” 	Lesson 4, Activity 3.1
The 5 R’s to Waste - I can Refuse, Reduce, Reuse, Repair, and Recycle – Worksheet <ul style="list-style-type: none"> • One sheet per student 	Lesson 4, Activity 3.2
We pledge to.... – Class Printout <ul style="list-style-type: none"> • One copy for the entire class 	Lesson 5, Activity 3
PowerPoint – Fully created PowerPoint outlining all of the information within the lesson, including the vocabulary words, links to all videos, photos, and screenshots of the in-class worksheets.	Lessons 1-5

LESSON #1: VOCABULARY WORDS AND SINGLE-USE PLASTICS

LESSON #1: VOCABULARY WORDS AND SINGLE-USE PLASTICS

LESSON TIME: 45 MINUTES**ACTIVITY #1: VOCABULARY WORDS (25 MINUTES)**

Students learn about the lesson's vocabulary words. The teacher teaches the vocabulary word, uses it in a sentence, and then asks a question about the word.

Vocabulary words:

1. **Ocean** - The vast body of saltwater covering about three quarters of the earth's surface.
2. **Pollution** – Pollution happens when the environment is contaminated, or dirtied, by waste, chemicals, and other harmful substances. There are three main forms of pollution: air, water, and land.
3. **Plastic** - An artificial substance made from certain kinds of chemicals that can be easily shaped when soft.
4. **Micro plastic** - Microplastics are small plastic pieces less than five millimeters long which can be harmful to our ocean and aquatic life. Micro plastics come from larger pieces of plastic that break down in the ocean.
5. **Great Pacific Garbage Patch** - A vast accumulation of trash made up primarily of tiny plastic particles floating at the surface of the water in between California and Hawaii.
6. **Environmental change** - Disturbance of the environment most often caused by human influences and natural ecological processes.
7. **Food web** - The interlocking food chains within an ecological community.
8. **Reduce** – To make less in amount or size.
9. **Reuse** – To use something more than once or often.
10. **Recycle** - The process of taking materials ready to be thrown away and changing them into reusable materials.
11. **Compost** - A mixture of decaying leaves, vegetables, or manure that is used to improve garden soil.
12. **Single use plastic** – Plastic materials only designed to be used one time.

ACTIVITY #2: “LIFE OF A SPOON VIDEO” AND SINGLE-USE PLASTICS WORKSHEET (20 MINUTES)

Activity 2.1: “Life of a Spoon” Video (1 minute, 55 seconds)

Show the video titled, “Life of a Spoon” to the students. This video by Greenpeace shows the entire process that goes into making a single use plastic spoon that will be used only once.

- [Click here to watch the video.](#)
- Link to the video: <https://www.youtube.com/watch?v=eg-E1FtjaxY>

LESSON #1: VOCABULARY WORDS AND SINGLE-USE PLASTICS

Activity 2.2: Single Use Plastics – Identification and Alternatives Worksheet (18 minutes)

After watching the video “Life of a Spoon,” the students learn how much time and energy goes into making something that will only be used once. Students will then work independently on the “Single Use Plastics – Identification and Alternatives” Worksheet. In this worksheet, students will write about single use plastics and then identify two different single use plastics that they use within their lives. They will then propose alternatives to these single use plastics.

- For this activity, project the definition of single use plastics onto the whiteboard (slide 17 in the PowerPoint) for the students to see the definition and the photos on this slide.

- Some options of single use plastic products, along with the replacement, that students could write about includes:
 - Single use plastic water bottle --> Reusable water bottle
 - Single use plastic spoon --> Reusable metal spoon
 - Plastic shampoo bottle --> Shampoo bar
 - Individual packages of chips/cookies --> Placing these items in reusable containers
 - Plastic straw --> No straw or metal straw
 - Plastic grocery store bag --> Reusable cloth bag
 - Thin plastic produce bag --> Cloth produce bags

LESSON #2: OCEAN PLASTICS ARE A BIG PROBLEM

LESSON #2: OCEAN PLASTICS ARE A BIG PROBLEM

LESSON TIME: 45 MINUTES**ACTIVITY #1: VIDEO AND DISCUSSION (10 MINUTES)**

Students start by watching the video, “How much Plastic is in our Ocean.” This video explains the Great Pacific Garbage Patch, what microplastics are, and provides some tips on how to reduce individual plastic usage.

After watching the video, the students will engage in a brief five-minute discussion. The following questions can be used to guide the discussion:

1. Why are microplastics a problem?
2. Where is plastic found in the ocean?
3. Why do animals eat the microplastics?

Video: “How much Plastic is in our Ocean” (5 minutes)

- [Click here to watch the video.](#)
- Link to the video: <https://www.youtube.com/watch?v=YFZS3Vh4lFI>

ACTIVITY #2: READING, QUIZ, & DISCUSSION (15 MINUTES)**Activity 2.1 – Reading “Tons of Trash in the Ocean Hurt Animals” (7 minutes)**

Students read the article titled “Tons of Trash in the Ocean Hurt Animals.” This article discusses ocean trash and explains the Great Pacific Garbage Patch. The article contains roughly 400 words.

Activity 2.2 – “Tons of Trash in the Ocean Hurt Animals” Quiz (8 minutes)

After the students are done reading the article, the students will take a four-question quiz about the reading. The Power Point contains the quiz questions, with the answer on the following slide after each quiz question. Students can either answer the questions on their white boards, or by holding up either 1 to 4 fingers to represent their answer choice.

- Link to article: <https://newsela.com/read/elem-great-pacific-garbage-ocean-patch/id/41749/>
- Please note that this article is found on Newsela.com. You will need to make a free account to access this article via the link provided above. A PDF version of the article is also attached to the unit materials.

LESSON #2: OCEAN PLASTICS ARE A BIG PROBLEM

ACTIVITY #3: RIVERS AND STREAMS CONNECT TO OUR OCEANS (20 MINUTES)**Activity 3.1: Video: “What really happens to the plastic that you throw away” (3-5 minutes)**

Students will watch the video “What really happens to the plastic that you throw away?” The segmented part of the video shows how a plastic water bottle can move from a stream to a river into the ocean. This video and activity are particularly important for those students who live great distances away from the ocean, to show how rivers and streams all connect to lakes or oceans.

Video: What really happens to the plastic that you throw away? (segmented: 1 minute, 30 seconds) (whole video: 4 minutes 6 seconds)

- [Click here to watch the video](#)
- Link to the video: https://www.youtube.com/watch?v=_6xINyWppB8
- Note: Play the video from to 1:53 to 3:15. You can also play the entire video. However, this portion of the video shows how plastic bottles that end up in streams can make its way into the ocean.

Activity 3.2: How Rivers and Streams connect to our ocean - Worksheets (15 minutes)

Students will complete the worksheet titled “How rivers and streams connect to the ocean.” This activity is a place-based activity, showing students how the major rivers along with smaller rivers and streams connect to the ocean. Students will identify where they are located on the map. They will then trace the rivers and/or streams that goes from their location to the ocean. After this, students will write a few sentences describing how plastics thrown into rivers can make their way into the ocean.

LESSON #3: OCEAN POLLUTION EXPERIMENT

LESSON #3: OCEAN POLLUTION EXPERIMENT**LESSON TIME: 45 MINUTES****ACTIVITY #1: OCEAN POLLUTION EXPERIMENT (20 MINUTES)**

Students conduct an ocean pollution experiment. In this experiment, a plastic tub represents the ocean. At first, the water in the ocean is clean. Once trash and oil are added to the tub, the students see that the water is dirty. Then, students begin to attempt to clean up the tub and see that cleaning up the ocean is a difficult challenge. The key takeaway is that students see that cleaning up oceans and rivers is much harder than simply discarding our trash in a responsible manner.

Activity #1.1 – Pre-Pollution (5 minutes)

The teacher takes a clear plastic tub and puts water into the tub. If the teacher has toy ocean animals or figurines, the teacher can put these in the water to represent ocean animals. The teacher tells the students that the tub represents the ocean and/or river.

The teacher makes three columns on the whiteboard, with the following headings: Pre-Pollution, Pollution, and Clean-up.

The teacher asks the students to describe what the tub looks like using a few adjectives or a short sentence. The teacher writes some of these words on the board under the column “Pre-Pollution.”

The teacher then takes a sample of the water and puts it into a jar before moving on.

Activity #1.2 – Adding in Pollution (10 minutes)

Students start to put different pieces of trash into the tub. This trash could have been collected from the playground by the students before coming into class, or the teacher can bring some trash for the experiment. Trash could include plastic containers, plastic bags, chip bags, plastic bottle tops, water bottles, etc. After the students put the trash into the bin, the teacher puts a few tablespoons of oil or balsamic vinegar into the tub, which shows oil pollution from oil spills. Then the students put in a handful of used coffee grounds or dirt into the water and explains that this represents microplastics.

The teacher asks the students to describe what they see in the dirty water. The teacher writes some of the words on the board in the column titled “pollution.”

The teacher again takes a sample of the polluted water and puts it into a jar.

LESSON #3: OCEAN POLLUTION EXPERIMENT

Activity #1.3 How Whales Eat Ocean Plastic (5 minutes)

Students then watch the National Geographic video titled, “See Blue Whales Lunge for Dinner in Beautiful Drone Footage.” This video shows how whales open up their mouths in order to eat and then filter out the water through their blow holes. This video shows students that some animals eat by taking big gulps of water filled with small fish. If there is plastic or other trash in the ocean, then the whales could mistakenly catch this in their mouths and digest the plastics.

After watching the video, the teacher can ask the following questions:

- How do whales eat?
- If there is plastic in the water, do you think that the whales might accidentally eat this?
- What happens if a whale accidentally eats plastic?

Video: “See Blue Whales Lunge For Dinner in Beautiful Drone Footage” (1 minute, 28 seconds)

- [Click here to watch the video.](#)
- Link to the video: <https://www.youtube.com/watch?v=cbxSBDopVyw>

ACTIVITY #2: CLEANING UP THE MESS AND WORKING ON THE WORKSHEET (20 MINUTES)**Activity #2.1 – Working on the worksheet**

The teacher will hand out the worksheet titled “Ocean Plastic – The Problem and the Solution.” The students will work on the first page of this worksheet, where they will draw the dirty ocean, similar to what they witnessed during the experiment. Then, they will write a paragraph describing why plastic and trash that ends up in our ocean is a problem.

Activity #2.2 – Cleaning up the water

While the class is working independently on the worksheet, the teacher will call groups of students to the tub to help clean up the water. Students begin taking turns attempting to clean up the trash, oil, and dirt within the tub. The students can first try cleaning up the trash with a net or picking out the pieces of trash with their hands. However, once all of the trash is gone, the water is still dirty. Students then use sponges, a coffee filter, or cotton balls to clean up the oil and other dirt within the water. Each student will see that even though they attempted to clean the water many different ways, it is still dirty.

While the students are cleaning up the trash, the teacher can ask the students to describe the water and the clean-up process. The teacher can write some of these words on the board in the column titled, “Clean-up.”

After the water is cleaned to the best of the student’s abilities, the teacher will then take a sample of the water and put it into a jar.

LESSON #3: OCEAN POLLUTION EXPERIMENT

Activity #3 – Experiment wrap-up (5 minutes)

The teacher will show the students the three jars full of water, which shows the clean water, the dirty water, and the water after the students have cleaned up the water. The teacher will engage the students in a wrap up discussion, and can ask the students the following questions:

- What happened during the experiment?
- Was the water easy or hard to clean up?
- Is the water after the pollution as clean as the water before the pollution?
- Why is it bad for trash and plastics to be in our ocean?
- How can we stop plastic and trash from entering into the ocean?

*Similar activity with photos can be found [here](#).

LESSON #4: SOLUTIONS TO THE PLASTICS PROBLEM

LESSON #4: SOLUTIONS TO THE PLASTICS PROBLEM

LESSON TIME: 45 MINUTES**ACTIVITY #1: SOLUTIONS – TECHNOLOGIES (10 MINUTES)**

Explanation: In Lesson #3, Activity #2, students learned first-hand how hard it is to clean up the ocean. Now, students will learn about the Ocean Cleanup Project, which is a non-profit that has created an autonomous and solar run technology that is designed to pick up 90% of the ocean trash by 2040. The technology is a U-shaped device that floats in the five ocean trash gyres and collects trash through a skirt that extends roughly 10-12 feet down. The device relies on currents and wind to move the U-shaped device to areas of the patch with the greatest amount of trash. A boat collects the trash periodically and recycles it back on land.

Activity #1.1 The Ocean Cleanup Videos (5 minutes)

Students will begin by watching the video titled “The Ocean Cleanup, System 001, Technology Explained.” This video gives a verbal and animated explanation of the U-Shaped Ocean Cleanup Technology and how it works. The students then watch the video “Ocean Cleanup: Plastic-harvesting device ‘successful,’” which shows actual images of how the device works and how it picks up the trash.

Video #1: [The Ocean Cleanup, System 001, Technology Explained](#) (two minutes, 2 seconds)

- Link to the video: <https://www.youtube.com/watch?v=O1EAeNdTFHU>

Video #2: [Ocean Cleanup: Plastic-harvesting device ‘successful’](#) (two minutes, six seconds)

- Link to the video: <https://www.youtube.com/watch?v=e-fl4ahyHNg>

Activity #1.2 The Ocean Cleanup Discussion (5 minutes)

After watching the videos, the students will participate in a short class discussion talking about the videos. The PowerPoint contains a few slides with photos from the Ocean Cleanup, which can be shown to students while the discussion is taking place.

Potential questions to ask during the discussion:

- What did you learn from the video?
- Why is it important to pick up the ocean trash?
- The device is run off of solar power. Does anyone know what that means?

LESSON #4: SOLUTIONS TO THE PLASTICS PROBLEM

ACTIVITY #2 LEARNING ABOUT THE SOLUTIONS (12 MINUTES)**Activity #2.1 – Refuse, Reduce, Reuse, Repair, and Recycle – PowerPoint slides (6 minutes)**

Students start by learning about the five R's, which are refuse, reduce, reuse, repair, and recycle. Learning about this can allow the students to properly manage their trash, which is one solution to reducing the amount of trash generated in general, and the amount of trash that ends up in our oceans. Refer to the PowerPoint to teach this part of the lesson.

Activity #2.2 – “Composting for Kids” video (6 minutes)

Students will watch the video titled “Composting for Kids.” This video goes over why composting is important, shows what can be composted, and explains a school composting system. This information will be used during activity #3.

Industrial composting can take any type of edible food scraps, which is where most school compost is sent to. Please note that what can go in the compost bin at school is different than what can go into a backyard compost pile. Backyard compost piles should not have any meat, dairy, or bread products. This is because it attracts unwanted animals to the bin. Additionally, commercial composting facilitates get warm enough to break down these meat and dairy products much quicker and more efficiently than a backyard system.

Video: “Composting for Kids” video (5 minutes, 56 seconds)

- [Click here to watch the video](#)
- Link to the video: <https://www.youtube.com/watch?v=dRXNo7Ieky8>

ACTIVITY #3 - SORTING ACTIVITY AND FIVE 5 R'S WORKSHEET (23 MINUTES)

Directions: The teacher will work with small groups of students and have them participate in a hands-on sorting activity. The rest of the class will be working independently on the worksheet titled “The 5 R's to Waste – I can Refuse, Reduce, Reuse, Repair, and Recycle.” The teacher will pass out and explain the worksheet. Then, the teacher will work with small groups on the sorting activity.

Activity #3.1 – Sorting Activity

While students work independently on the worksheet, the teacher will work with small groups of students on the sorting activity. Here, students will need to sort different items into either the recycling, composting, or trash buckets. Photos for this activity can be found in the document titled “Objects to print for the sorting activity” along with an answer sheet. The activity will take roughly 4-5 minutes per group.

Activity #3.2 – Refuse, Reduce, Reuse, Repair, and Recycle Worksheet

Students will work independently on the worksheet titled “Refuse, Reduce, Reuse, Repair, and Recycle.” In this worksheet, students will have to give two examples for each of the 5 R's by writing a short sentence for each of the examples.

LESSON #5: SOLUTIONS, PRESENTATIONS, AND CLASS PLEDGE

LESSON #5: SOLUTIONS, PRESENTATIONS, AND CLASS PLEDGE

LESSON TIME: 45 MINUTES**ACTIVITY #1: FILLING OUT THE SOLUTIONS WORKSHEET (25 MINUTES)**

Students will fill out the second page of the worksheet titled, “Ocean Plastic – The Problem and the Solution.” The second page is where the students will draw a photo of the two solutions that they have come up with and then write two to three sentences describing the solution. The solutions can be anything that the student has learned in class or can be something they invent. One of the solutions should be something that the student could implement into their own lives.

Example of possible solutions:

- Picking up trash on the streets
- Picking up trash on the playground
- Not littering
- Recycling
- Composting
- Making a poster encouraging other students to properly dispose of their own trash
- Having a river or beach clean-up day (depending on the school’s location)
- Any “invention” that the student comes up with

ACTIVITY #2: PRESENTATION TIME (10 MINUTES)

Students will be given 10 minutes to share and talk about their solutions. This could be done by:

1. Asking for a few volunteers to share their solution with the class.
2. Having students get into small groups and each student share their solutions to the group.

ACTIVITY #3 (10 MINUTES): CALL TO ACTION: PLEDGE

Now that the students know about the problem of plastics in our ocean and rivers, and have come up with several solutions, the students can create a class pledge and commit to taking action at their school. The teacher will ask students to volunteer some solutions that they could implement at their school. The teacher can write a few of the most practical ideas on the white board. The teacher can lead the students to decide on one practical solution that the students can pledge to do at their school to stop pollution from entering waterways, rivers, and the oceans.

LESSON #5: SOLUTIONS, PRESENTATIONS, AND CLASS PLEDGE

ACTIVITY #3 (10 MINUTES): CALL TO ACTION: PLEDGE

Once the solution is created, the teacher can write the solution on the printout titled, “We pledge to.” Then, all of the students can sign their names on the paper. This paper could be hung up on the classroom door, in order for the students to see the pledge on a daily basis.

Examples of practical solutions that students can pledge to do at school:

1. Pick up a piece of trash on the playground everyday.
2. Make sure that you properly throw away, compost (if available), and recycle your trash after lunch.
3. Tell other students about the importance of picking up trash.
4. On a certain day of the week, every student spends the first two minutes of their recess picking up trash on the playground.

TEACHER RESOURCES

TEACHER RESOURCES

This section contains resources for teachers to learn more about the environmental and sustainability topics presented within this unit plan, including information about ocean plastics, composting, scientific articles about climate change, and extra resources for students. If you need more information regarding why climate change, sustainability, and environmental literacy should be taught within Elementary Schools, please email the content creator of this unit plan for more information.

INFORMATION ON OCEAN PLASTIC:

[The Ocean Cleanup: Website](#)

- The Ocean Clean-up is an organization that has created a technology to clean up all of the five ocean garbage patches that accumulate in the five large gyres around in our oceans. This website gives a detailed overview of the technologies used to reach the goal of collecting 90% of all ocean plastic by 2040.
- The Ocean Clean-up is the technology discussed in Lesson #4, Activity #1.

INFORMATION ON GLOABL WARMING

Article by NASA: [The Causes of Climate Change](#)

- This article explains the root causes of climate change, explains the greenhouse effect, and discusses the various gasses which most contributes to climate change.
- “In its Fifth Assessment Report, the Intergovernmental Panel on Climate Change, a group of 1,300 independent scientific experts from countries all over the world under the auspices of the United Nations, concluded there’s a more than 95 percent probability that human activities over the past 50 years have warmed our planet.”

Video and Article by The Royal Society: [The Basis of Climate Change](#)

- This article contains a short one-minute video titled “Climate Change in 60 Seconds.” The article covers the scientific claims that the Earth has been heating at a much faster pace since the start of the Industrial Revolution, where humans began to burn fossil fuels.
- “Many other impacts associated with the warming trend have become evident in recent years. Arctic summer sea ice cover has shrunk dramatically. The heat content of the ocean has increased. Global average sea level has risen by approximately 20 cm (8 inches) since 1901, due both to the expansion of warmer ocean water and to the addition of melt waters from glaciers and ice sheets on land.”

Article on Oxford Academic: [World Scientist’s Warning of a Climate Emergency](#)

- This article provided two figures, which are titled “Change in global human activities from 1979 to the present” and the “Climatic response time series from 1979 to the present.” The article provided six important actions that need to happen in order for our climate to stabilize. Those include energy, short-lived pollutants, nature, food, the economy, and population.

TEACHER RESOURCES

INFORMATION ON COMPOSTING

Video: [How Composting Helps to Save the Environment](#)

- This 3-minute video goes over why composting is a helpful tool to help save the environment. Key findings include that more than 50% of the waste that we throw away can be composted. When food and yard scraps end up in the landfill, the food scraps naturally release liquids, which mixes with other harmful chemicals inside the landfill, which creates a liquid called leachate. This leachate is very harmful if exposed to groundwater, which could lead to water contamination.

EXTRA RESOURCES FOR STUDENTS

Video: [Kids Take Action Against Ocean Plastic](#) (4 minutes, 12 seconds)

- This video is placed in Hawaii and talks about kids taking action against ocean plastic. The video shows students identifying plastic pollution that is ending up on their beaches and talks about the plastics issue in the ocean.
- This video can be shown to the students, if there is extra time during one of the lessons.

STUDENT WORKSHEET**SINGLE USE PLASTICS – IDENTIFICATION AND ALTERNATIVES**

Name: _____

Single use plastics are: _____

Directions: Identify a single use plastic that you use in your own life. Then, identify a different alternative that can replace the single use plastic items. This new product would last longer, produce less waste, and would conserve resources.

Example:

1. Single use plastic product #1: One single use plastic product that I use is a plastic sandwich bag to hold my sandwich.

Replacement: I could use a metal container or Tupperware to store my sandwich to replace the single use plastic bag.

1. Single use plastic product #1: _____

Replacement: _____

2. Single use plastic product #2: _____

Replacement: _____

Why is it important to conserve resources and reduce our plastic waste? _____

STUDENT WORKSHEET

HOW RIVERS AND STREAMS CONNECT TO THE OCEAN

Name: _____

Directions: Circle the state that you live in with a marker. Then, trace one of the smaller or big rivers from your state to the ocean or nearby lake.



Are you located close to the ocean or far away? _____

How many states does the river pass through from your city to get to the ocean? _____

How can plastic thrown into a river or stream in your city end up in the ocean?

STUDENT WORKSHEET

**THE 5 R'S TO WASTE - I CAN REFUSE, REDUCE, REUSE,
REPAIR, AND RECYCLE**

Name: _____

Directions: List two examples of ways you can use the 5 R's in your life.

List two examples of how to **Refuse**:1. *I will refuse single use plastic water bottles and drink from a reusable cup at home.*

2. _____

3. _____

List two examples of how to **Reduce**:

1. _____

2. _____

List two examples of how to **Reuse**:

1. _____

2. _____

List two examples of how to **Repair**:

1. _____

2. _____

List two examples of how to **Recycle**:

1. _____

2. _____

STUDENT WORKSHEET - PAGE 1 OF 2

OCEAN PLASTIC –THE PROBLEM AND THE SOLUTION

Name: _____

Directions: Draw a photo describing the plastic pollution problem in our ocean.



Describe the plastic pollution problem in our ocean:

STUDENT WORKSHEET - PAGE 2 OF 2

OCEAN PLASTIC –THE PROBLEM AND THE SOLUTION

Directions: Draw two photos and write the name of two solutions to reduce plastics in the ocean.

Solution #1:	Solution #2:

Description of solution #1:

Description of solution #2:



Tons of trash in the ocean hurt animals

By Los Angeles Times, adapted by Newsela staff on 04.02.18

Word Count 397

Level 380L



Image 1. A piece of floating debris snagged during an ocean sampling operation. Photo from Ocean Cleanup/TNS.

The Great Pacific Garbage Patch is a big glob of trash. It floats in the middle of the Pacific Ocean. It is between California and Hawaii. It is mostly made of plastic. It is very big. A lot bigger than we thought it was. It is twice the size of Texas. And it is only getting bigger.

A team of scientists were curious about the garbage patch. They wanted to measure how big it was. They were in for a surprise. The patch was much larger than they expected. Worse, it is still growing!

Laurent Lebreton led the group. He called the garbage "frightening."

Plastic Can Hurt Animals

Plastic is very useful. Plastic bags help us with our groceries. They can hurt our oceans, though. Animals can eat plastic bags. They can be hurt if they try to. Shellfish and other animals can stick to the plastic. Fish and birds then eat these animals. Soon, the plastic has hurt the whole food chain!

Mr. Lebreton's team wanted a bird's-eye view of the trash. They studied what it looked like from above. They also sent boats to take pieces of trash. The scientists looked at these pieces very closely. Most of the garbage patch is made of tiny bits of plastic. This time, the scientists got to see bigger pieces, too.

41 Years Ago!

Where did all that trash come from? Fishing nets are part of the problem. They made up a big part of the garbage patch. Fishing boats leave them behind. Then they drift through the ocean. Animals can get stuck in the nets.

Fifty plastic items had dates printed on them. Most were from the 1990s and 2000s. One was from 1977. That is 41 years ago! There were 386 items with words from different languages. Many were in Japanese.



Giant Wave

Why might that be? The scientists have a guess. In 2011, Japan was hit by



a tsunami. The giant wave washed tons of trash into the sea. That trash could have floated across the ocean. Then it could have made its way to the garbage patch.

This study just looked at floating plastic. There might be much more on the ocean floor.

OBJECTS TO PRINT

OBJECTS TO PRINT

Objects to print for the composting activity.

Key for composting activity

Compost

- Blueberries
- Banana Peel
- Applesauce
- Hamburger
- Chicken Tenders
- Carrots
- Half eaten PB&J
- Pizza
- Bread
- Orange peels
- Apple juice
- Apple core
- Salmon and Pasta
- Cookies
- Pretzels

Recycling

- Plastic water bottles
- Plastic applesauce container

Trash

- Fruit Rollup Package
- Starburst package
- Plastic sandwich bags
- Milk cartons
- Spork
- Fruit squeeze packs (packaging)
- Styrofoam tray
- Plastic wrap



OBJECTS TO PRINT



OBJECTS TO PRINT



OBJECTS TO PRINT



OBJECTS TO PRINT



Appendix D

Second Grade Unit Plan - Our Melting Oceans, Solid and Liquid Water

OUR MELTING OCEANS: SOLID AND LIQUID WATER

SECOND GRADE SUSTAINABILITY THEMED UNIT PLAN



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INTRODUCTION**TABLE OF CONTENTS****Introduction**

Standards	1
Desired Results	2
Materials Needed	3

Lesson Plans and Resources

Lesson #1: Solid and liquid bodies of water	4
Lesson #2: How global warming is heating up our earth	6
Lesson #3: Introduction to Climate Change	9
Lesson #4: Composting 101 – Information, Activity, and Worksheet	12
Lesson #5: Wrap-up and Presentation	15
Teacher Resources	16

Student Worksheets

Our Ocean Ice is Melting!	17
Ice Cube Experiment	18
What Causes Climate Change and How to Help	19
What to Compost	21

Additional Information

Objects to Print	22
------------------------	----

INTRODUCTION

STANDARDS**MAIN STANDARDS**

2-ESS2-3: Obtain information to identify where water is found on Earth and that it can be solid or liquid.

K-2-ETS1-1: Engineering Design - Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

STANDARD CONNECTIONS

2-ESS2-1 Earth's Systems - Connections to the Nature of Science, Crosscutting Concepts: Science addresses questions about the natural and material world. Scientists study the natural and material world.

2-ESS2-1 Crosscutting Concepts - Connection to Engineering, Technology, and Application of Science: Developing and using technology has impacts on the natural world.

Colorado Academic Standards: Second Grade, Standard 1: Physical Science. Grade Level Expectations: Matter exists as different substances that have observable different properties.

INTRODUCTION

DESIRED RESULTS**OBJECTIVE**

Students will describe that there is both solid and liquid water in the ocean and that ocean ice is melting faster due to climate change. Students will identify and learn about different solutions to mitigate climate change.

ESSENTIAL QUESTIONS

1. Can water be found in both a solid and liquid form?
2. Why does water melt?
3. Why are the ice sheets melting?
4. Is climate change caused by human activities?
5. What are some ways that humans can reduce their impact on the environment?

FACTUAL KNOWLEDGE

Students will learn:

1. Water on Earth can be found in both a solid and liquid state.
2. A basic understanding of climate change for their grade level.

PROCEDURAL KNOWLEDGE

Students will be able to:

1. Conduct an experiment showing when the outside air temperature or water temperature increases, solid water will melt into liquid water.
2. Identify which items can be composted and which items cannot be composted.

CONCEPTUAL KNOWLEDGE

Students will understand:

1. That human activity is causing climate change, which has led to ice sheets melting at a faster pace.
2. Several different solutions to climate change that the students can implement into their own lives.

PERFORMANCE TASK

Students will create a poster, either individually or in small groups. The poster will show:

1. Students' understanding that water is found in a solid and liquid form in the ocean. Students will draw ocean ice in a liquid state, solid state, and a melting state.
2. Different solutions that the students have identified to reduce their carbon footprint.

INTRODUCTION

MATERIALS NEEDED

Materials	Lesson and Activity
“Our Oceans are Melting” – Final Project Poster/Worksheet <ul style="list-style-type: none"> Option #1: Print out a copy of the paper titled “Our Ocean Ice is Melting” Option #2: Provide students with a large piece of poster paper. Project the printout and have students draw the layout themselves. This option would be useful if the final project is intended to be displayed within the classroom. 	Lesson #1, Activity #2.3 Lesson #5, Activity #1-2
Ice cube experiment: <ol style="list-style-type: none"> Ice cubes – 10 to 14 pieces Cooler Bowls – 8 8 cups of hot water Thermos – to hold hot water 8 cups of cold water Hot and cold labels - 4 of each 	Lesson #2, Activity #1
“Ice Cube Experiment” – Student Worksheet <ul style="list-style-type: none"> One paper per student 	Lesson #2, Activity #1.3
Composting 101 (Optional if compost is available. Photos provided if compost if not available) <ol style="list-style-type: none"> Compost with large pieces of food waste Compost that is halfway through the process Finished compost Bowls or jars to hold the compost 	Lesson #3, Activity #1
“What Causes Climate Change and How to Help” – Student Worksheet <ul style="list-style-type: none"> One paper per student 	Lesson #3, Activity 3.2
Composting Hands on Demo <ol style="list-style-type: none"> Print out the photos in the attached document titled, “Objects to print out for the composting demo” Bin titled compost Bin titled trash Bin titled recycling 	Lesson #4, Activity #1
“What to Compost” – Student Worksheet <ul style="list-style-type: none"> One paper per student 	Lesson #4, Activity 2.2
PowerPoint – Fully created PowerPoint outlining all of the information within the lesson, including the vocabulary words, links to all videos, photos, and screenshots of the in-class worksheets.	Lesson #1-5

LESSON #1: SOLID AND LIQUID BODIES OF WATER

LESSON #1: SOLID AND LIQUID BODIES OF WATER**LESSON TIME: 45 MINUTES****ACTIVITY #1 (25 MINUTES): VOCABULARY WORDS**

Students learn about the lesson's vocabulary words. The teacher teaches the vocabulary word, uses it in a sentence, and then asks a question about the word.

Vocabulary words:

1. **Solid:** Having a firm shape or form that can be measured in length, width, and height.
2. **Liquid:** A form of matter that flows easily and can take on the shape of any container it is poured into.
3. **Melt / Melting:** To change from a solid to a liquid state.
4. **Ice sheet:** A thick layer of ice covering a large area for a long time.
5. **Climate change:** A change in global and regional climate patterns from humans burning fossil fuels, such as electricity or natural gas.
6. **Emissions:** Particles that are released into the air by the burning of fossil fuels.
7. **Climate:** The usual weather conditions in a place, over the course of many years.
8. **Weather:** The conditions outside right now or next week.
9. **Compost:** A mixture of decaying leaves, vegetables, or manure that is used to improve garden soil.

ACTIVITY #2 (20 MINUTES): VIDEOS/DISCUSSION AND STARTING ON THE POSTER**Activity #2.1 – Photos of ocean water in a solid and liquid state (5 minutes)**

The teacher shows students photos on the PowerPoint provided, which shows photos of the ocean in both a solid and liquid state. The teacher can ask the students the following discussion questions while the students look at the photos.

Potential Discussion Questions to ask students while looking at the photos:

1. What do you see in the photos?
2. What type of plants and animals live in the ocean?
3. It is cold in parts of the ocean where there is ice?
4. Have you ever been to the ocean?

Activity #2.2 – Glacier video and discussion (5 minutes)

Students watch the video "Ilulissat Glacier, June 2007 - June 2009" to show how an ice sheet moves and deposits glaciers into the ocean. The ice sheet shown in the video flows at 125 feet per day, which is double the pace that the same ice sheet was moving 10 years ago. This ice sheet is "Greenland's single largest contributor to global sea level rise" (NASA Global Climate Change). After the video, the teacher can ask students some discussion questions.

LESSON #1: SOLID AND LIQUID BODIES OF WATER

Potential Discussion Questions to ask students after viewing the video:

1. What did you see happening in the video?
2. Is the ice sheet big or small?
 - a. How do you know?
3. Does anyone know why this ice sheet is moving?

Video: “Ilulissat Glacier, June 2007 - June 2009” (51 seconds)

- [Click here to watch the video](#)
- Link to the video: <https://climate.nasa.gov/interactives/global-ice-viewer/#/2/22>

Activity #2.3 – Individual work on “Our Oceans are Melting” poster (10 minutes)

Students will start working on the poster titled “Our Oceans are Melting”. They will draw and/or write a few words describing: solid ocean water, melting ocean ice, and liquid ocean water. The teacher can walk around the classroom and assist students as needed.

LESSON #2: HOW GLOBAL WARMING IS HEATING UP OUR EARTH

LESSON #2: HOW GLOBAL WARMING IS HEATING UP OUR EARTH

LESSON TIME: 45 MINUTES**ACTIVITY #1 (35 MINUTES): ICE CUBE EXPERIMENT****Activity #1.1: Describing the experiment to the students (5 minutes)**

The teacher will describe the experiment to the students. Here is a script that the teacher can use to describe the experiment:

- Yesterday we learned the words solid, liquid, and melting. Can anyone tell me what solid, liquid, and melting means? [students answer these questions].
- We are going to conduct an experiment today where we will see for ourselves how ice melts when placed in warm and cold water. We will see which ice cubes will melt the fastest, depending on the heat of the water.

Activity #1.2: Conducting the Experiment (20 minutes)

Students conduct an experiment where they take two ice cubes and watch how the ice cubes in a cold environment would melt much slower than an ice cube in a warm environment. This activity is to show students how increases to air or water temperature will make the ice sheet and ocean ice melt much faster.

Experiment description, depending on the outside weather:

- One ice cube is put in cold water and another ice cube is put in warm/hot water. Students see the effects that the ice cubes have on warming oceans, where the hot water represents warming oceans. Photos of this experiment are shown on the PowerPoint.

Activity 1.2A: Setting up the experiment (5 minutes)

1. First set up two bowls in four different parts of the room.
2. Pour cold water into one of the bowls. Replicate this process for all of the other three stations.
3. Then, pour hot water into one of the bowls. Replicate this process for all of the other three stations. Note, this water just needs to be warm and not boiling. Bring warm water in a thermos or get hot water from the classroom's sink.
4. Have students write "hot" and "cold" on a scrap piece of paper and put this next to the bowl.
5. Have students put one piece of ice into each of the bowls.

LESSON #2: HOW GLOBAL WARMING IS HEATING UP OUR EARTH

Activity 1.2B: During the experiment (15 minutes)

1. The teacher will be keeping time and checking on the ice cubes every minute.
2. Students can watch and take note on how fast the ice melts depending on the water temperature. The students can fill out the worksheet titled “Ice Cube Experiment” while watching the experiment.
3. The class will discuss what is happening to the ice cubes in their own groups.
4. The students can stick their hands in the hot and cold water, to understand why the ice cube would melt more in the hot water versus the cold water.
 - a. Note: The hot water should not be boiling for safety purposes. The water temperature of a warm/hot shower will be sufficient.

Activity 1.3: Filling out the worksheet (15 minutes)

Students fill out the worksheet titled “Ice Cube Experiment” during and after the experiment. While the students are filling out the worksheet, the teacher can go around the room helping students. Students that finish the assignment quickly can help clean up the experiment.

ACTIVITY #2 (10 MINUTES): MELTING OCEAN ICE DISCUSSION AND VIDEO.**Activity 2.1: Melting Oceans Discussion (5 minutes)**

The teacher starts the activity by posing some discussion questions to the students related to the activity.

Possible discussion questions:

- What did you see happen during the experiment?
- Why did the ice melt faster in the hot water than in the cold water?
- What happens to ocean ice in the summer?
- What happens to ocean ice in the winter?
- If ocean temperatures rise globally, what will happen to the ocean ice?

After the activity is completed, students learn that it is natural for some ocean ice to melt in the summer. However, with temperatures increasing throughout the world, students learn that ocean ice is melting at a faster pace and is not re-freezing in the winter.

LESSON #2: HOW GLOBAL WARMING IS HEATING UP OUR EARTH

Activity 2.2: Optional Activity (time permitting): “Sea Level Rise Video” (5 minutes)

Optional video: NASA’s Earth Minute: Sea Level Rise (1 minute, 30 seconds)

The video explains why oceans are rising and the impact that this will have on our Earth. If there is not enough time to show the video, Lesson #3 will go further into this topic.

- [Click here to watch the video "NASA's Earth Minute: Sea Level Rise"](#)
- Link to the video: <https://www.youtube.com/watch?v=msnOHuPep9I>

Discussion questions after the video:

1. What did you learn from the video?
2. Why are sea levels rising?
3. What do you think will happen if sea levels rise?

LESSON #3: INTRODUCTION TO CLIMATE CHANGE

LESSON #3: INTRODUCTION TO CLIMATE CHANGE**LESSON TIME: 45 MINUTES****ACTIVITY #1: REVIEW (5 MINUTES)**

Students will review the activity that took place during lesson #2 via a group discussion.

The teacher can ask the following questions during this review:

- What is solid water?
- What is liquid water?
- What is melting water?
- What did we do yesterday during our melting ice experiment?
- What did we learn from the melting ice experiment?

ACTIVITY #2 : CLIMATE CHANGE - MELTING THE ICE SHEETS (10 MINUTES)**Activity #2.1: Watch both videos (5 minutes)**

Students watch the video titled “Oceans of Climate Change,” which explains that our oceans are absorbing 80-90% of the extra heat in our atmosphere that is there because of humans burning fossil fuels.

Students then watch the video titled “Arctic Sea Ice Each September from 1979-2018,” which shows that the area of Arctic ice has been getting smaller and smaller over the last 50 years.

[Click here to watch the video “Oceans of Climate Change”](#) (3 minutes, 39 seconds)

- Link to video: <https://climatekids.nasa.gov/ocean/>

[Click here to watch the video “Arctic Sea Ice Each September From 1979-2018”](#) (54 seconds)

- Link to the video: <https://climatekids.nasa.gov/climate-change-evidence/>

Activity #2.2: Discussion on the videos (5 minutes)

After watching the two videos, the teacher has a short discussion with the class regarding global warming and our oceans heating up. The teacher can ask these following guiding questions:

- What did you learn from the video?
- What happens when our oceans heat up?
- Why is it bad for our oceans to heat up?

LESSON #3: INTRODUCTION TO CLIMATE CHANGE

ACTIVITY #3: SOLUTIONS TO CLIMATE CHANGE (30 MINUTES)**Activity 3.1: Discussing what causes climate change (15 minutes)**

Students learn about different causes of emissions that lead to our world heating up.

- People are emitting tons of carbon dioxide and greenhouse gases into the atmosphere.
Emissions are released by:
 - Driving combustion engine cars (gas powered cars)
 - Using electricity (aside from electricity from renewable sources)
 - Turning on the lights
 - Growing food (fertilizers used, transportation, water run-off, etc.)
 - Cow, chicken, and dairy production
 - Running appliances
 - Throwing away food instead of composting
 - Factories that produce different goods (e.g.: clothing, toys, appliances, furniture, books, cars etc.)

After this, students brainstorm different ways to reduce their use of emissions to reduce their impact on the environment. The options that the students come up with can be written on the white board to aid with the next activity.

- Potential solutions to climate change that students can do:
 - Turning off the lights when you leave the room
 - Unplugging appliances when not in use
 - Turning off the TV
 - Not driving in a car
 - Walking, riding a bike, or taking the bus to school or errands to reduce emissions released from driving
 - Reducing paper usage and reusing the back sides of paper
 - Reusing other items
 - Bringing reusable bags to the store
 - Bringing lunch in reusable containers
 - Using a reusable water bottle instead of a single-use plastic water bottle
 - Composting
 - Recycling
 - Eating less meat and dairy products (eating beef is one of the biggest contributors to greenhouse gas emissions in the USA)

LESSON #3: INTRODUCTION TO CLIMATE CHANGE

Activity 3.2: Student Worksheet – What Causes Climate Change and How to Help (15 minutes)

Students will be given 15 minutes to fill out the worksheet titled, *What Causes Climate Change and How to Help*.

- Note that this is a two-sided worksheet.

In the worksheet, students will be given four photos, which shows a problem affecting climate change. Students will use the word box titled “Problems Word Box” and match the four answers to the photos shown. Then, students will use the “Solutions Word Box” to find the solution that can help with that problem. Students will need to then draw a photo that shows the solution. An example is provided for the students within the document.

LESSON #4: COMPOSTING 101 - INFORMATION, ACTIVITY, & WORKSHEET

LESSON #4: COMPOSTING 101 – INFORMATION, ACTIVITY, AND WORKSHEET

LESSON TIME: 45 MINUTES

Information about composting: When food is thrown into the garbage, it releases methane, which is a harmful greenhouse gas that heats up the earth. Composting reduces the release of methane, saves room in the landfill, and gives back the food waste’s nutrients to the soil to create a regenerative process.

How this relates to the unit: The methane released from food sent to the landfill is one contributor to why our earth is heating, and thus why our ocean ice is melting and sea levels are rising.

ACTIVITY #1 (25 MINUTES): COMPOSTING 101**Activity 1.1: “Composting for Kids” video (10 minutes)**

Students will start by watching the video titled “Composting for kids.” This video goes over why composting is important, shows what can be composted, and explains a school composting system.

After the students watch the video, the teacher will engage the students in a short discussion about composting and the benefits of composting.

Potential questions to ask, with answers:

- What is composting?
 - Answer: Turning food scraps, sticks, and leaves into soil that is rich in nutrients.
- Why is it important to compost?
 - Answers: Composting gives back nutrients to the soil.
 - Composting saves space in the landfill.
 - Composting does not harm our ground water.
 - Composting does not release toxic emissions, which leads to global warming and melting the ice sheets.
- Does anyone compost at home?
- Do we compost here at school?

[Click here to watch the “Composting for Kids” video](#) (5 minutes, 56 seconds)

- Link to the video: <https://www.youtube.com/watch?v=dRXNo7Ieky8>

LESSON #4: COMPOSTING 101 - INFORMATION, ACTIVITY, & WORKSHEET

Activity 1.2: “How Compost is made Video” (10 minutes)

Students are shown the video “How Compost is Made,” which goes over how food scraps turn into useful soil. This video goes into the compost bin and shows how different organisms break down the compost via an animated video. After the video, the teacher can ask the students what they learned from the video.

[Click here to watch the “How Compost is Made” video](https://www.recyclenow.com/recycle/recycle-school/composting/how-compost-made) (6 minutes, 30 seconds)

- Link to the video: <https://www.recyclenow.com/recycle/recycle-school/composting/how-compost-made>

Activity 1.3: Composting Stages - Showing students compost (5 minutes)

Students will be shown different stages of compost in order for the students to visually see and understand the decomposition process.

- If composting is available: Students will be shown different stages of composting within the classroom. Students will be shown compost that has not yet been broken down, compost that is in the process of being broken down, and compost that is ready to use.
- If compost is not available: Photos of different stages of compost are provided within the PowerPoint.

ACTIVITY #2 (20 MINUTES): COMPOSTING HANDS-ON DEMO AND WORKSHEET

Directions: The teacher will work with small groups of students and have them participate in a hands-on composting activity. The rest of the class will be working independently on the “What to Compost” worksheet. The teacher will pass out the worksheet to each student and explain the worksheet. Then, the teacher will work with small groups on the composting hands-on activity.

Activity #2.1: Composting hands-on activity

Students participate in a composting demo and activity, where they sort out what can and cannot be composted. For the items that cannot be composted, the students will put these items either in the trash or recycling bin. Photos for this activity can be found in the last section of this unit plan titled, “Objects to print out for the composting demo” along with an answer sheet. The activity will take roughly 4-5 minutes per group.

LESSON #4: COMPOSTING 101 - INFORMATION, ACTIVITY, & WORKSHEET

Activity #2.2: What to Compost Worksheet

While small groups of students are participating in the composting hands-on demo, the other students are working independently on the handout titled, “What to Compost.” Students will need to draw different items that can be composted. On the worksheet, there are a few items, which gives students a general idea of what to draw. Student can draw any type of edible food, without the wrapper, along with natural items such as leaves and sticks.

- Please note that what can go in the compost bin at school, which is typically processed through a commercial compost system, is different than what can go into a backyard compost pile. Backyard compost piles should not have any meat, dairy, or bread products. This is because it attracts unwanted animals to the bin. Additionally, commercial composting facilitates get warm enough to break down these meat and dairy products much quicker and more efficiently than a backyard system.

LESSON #5: WRAP-UP AND PRESENTATION

LESSON #5: WRAP-UP AND PRESENTATION**LESSON TIME: 45 MINUTES****ACTIVITY #1 (15 MINUTES): POSTER COMPLETION**

Students will be given time to complete the last two boxes on the “Our Oceans are Melting” poster. Here, the student will write the name of the solution to climate change/ocean ice melting and also draw a photo of their solution on the poster.

ACTIVITY #2 (25 MINUTES): STUDENT PRESENTATION TIME

Students present their poster to the class, particularly discussing how ocean ice melts and their solutions that they came up with. Each student should talk for 30 seconds to one minute. Students can speak from their desks depending on time and how many students are in the classroom.

Each student can discuss the following points and can use their posters as a guide:

- How ocean water can be found in both a solid and liquid form.
- When it is hot, ice melts from a solid to a liquid form.
- Human activities are leading to ice sheets melting.
- Discuss ways that they (the student) can reduce their impact on the environment.

ACTIVITY #3 (5 MINUTES): FINAL DISCUSSION.

Students have a final discussion about the things that they learned this week. The teacher can use the following questions to guide the discussion, which are the essential questions from this unit:

- Can water be found in both a solid and liquid form?
- Why does water melt?
- Why are the ice sheets melting?
- Is climate change caused by human activities?
- What are some ways that humans can reduce their impact on the environment?

TEACHER RESOURCES

TEACHER RESOURCES

This section contains resources for teachers to learn more about the environmental and sustainability topics presented within this unit plan. If you need more information regarding why climate change, sustainability, and environmental literacy should be taught within elementary schools, please email the content creator of this unit plan for more information.

INFORMATION ON COMPOSTING

Article: [Why Should I Compost?](#)

- A short article explaining why composting is important for saving resources, improving soil health, reducing impacts on the environment, and saving money.

Video: [How Composting Helps to Save the Environment](#)

- This 3-minute video goes over why composting is a helpful climate mitigation tool. More than 50% of the waste that we throw away can be composted. When food and yard scraps end up in the landfill, the food scraps naturally release liquids, which mixes with other harmful chemicals inside the landfill, which creates a liquid called leachate. This leachate is very harmful if exposed to groundwater, which could lead to water contamination.

INFORMATION ON ICE SHEETS MELTING

Article by National Snow and Ice Data Center: [Quick Facts on Ice Sheets](#)

- This short article covers what ice sheets are, how they form, and how climate change is already impacting the ice sheets.

INFORMATION ON GLOABL WARMING

Article by NASA: [The Causes of Climate Change](#)

- This article explains the root causes of climate change, explains the greenhouse effect, and discusses the various gasses which most contributes to climate change.
- “In its Fifth Assessment Report, the Intergovernmental Panel on Climate Change, a group of 1,300 independent scientific experts from countries all over the world under the auspices of the United Nations, concluded there's a more than 95 percent probability that human activities over the past 50 years have warmed our planet.”

Video and Article by [The Royal Society: The Basis of Climate Change](#)

- Article contains a one-minute video titled “Climate Change in 60 Seconds.” The article covers the scientific claims that the Earth has been heating at a much faster pace since the start of the Industrial Revolution, where humans began to utilize and burn fossil fuels.
- “Many other impacts associated with the warming trend have become evident in recent years. Arctic summer sea ice cover has shrunk dramatically. The heat content of the ocean has increased. Global average sea level has risen by approximately 20 cm (8 inches) since 1901, due both to the expansion of warmer ocean water and to the addition of melt waters from glaciers and ice sheets on land.”

STUDENT WORKSHEET

OUR OCEAN ICE IS MELTING

Name: _____

Direction: In the boxes below, draw solid, melting, or liquid ocean water in each box.

Solid Ocean Water	Melting Ocean water	Liquid Ocean Water

Directions: Draw or write two solutions how we can help the ocean ice from melting.

Solution #1:	Solution #2:

STUDENT WORKSHEET

ICE CUBE EXPERIMENT

Name: _____

Describe the experiment: _____

Direction: Draw photos of what you see during each part of the experiment.

Cold Water

Start of the experiment	Middle of the experiment	End of the Experiment

Warm Water

Start of the experiment	Middle of the experiment	End of the Experiment

Results – Describe what you learned: _____

STUDENT WORKSHEET - PAGE 1 OF 2

WHAT CAUSES CLIMATE CHANGE & HOW TO HELP

Name: _____

Directions: Using the Problems Word Box, match the problems in the word box to the problems shown in the photo. Then, using the Solutions Word Box find a solution to solve the problem and draw a picture of the solution.



Problems Word Box


Driving a car	Throwing away food in the trash can
Using electricity when you do not need it	Buying things you do not need
Leaving the water running while brushing your teeth	

Solutions Word Box

Buying only things that you need	Turning off the lights when you leave the room
Riding a bike or taking the bus	Composting food waste
Turning off the water when you brush your teeth	

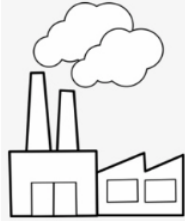

Example:

Problem	Solution
 <p><u>Problem:</u> Leave the water running while brushing your teeth</p>	 <p><u>Solution:</u> Turning off the water when you brush your teeth</p>

Problem	Solution
 <p>Problem:</p>	<p>Solution:</p>

STUDENT WORKSHEET - PAGE 2 OF 2

WHAT CAUSES CLIMATE CHANGE & HOW TO HELP

Problem	Solution
 <p>Problem:</p>	<p>Solution:</p>
 <p>Problem:</p>	<p>Solution:</p>
 <p>Problem:</p>	<p>Solution:</p>

STUDENT WORKSHEET

WHAT TO COMPOST

Name: _____

Directions: In the box below, draw different items that can be put into the compost bin.



School Compost Bin

OBJECTS TO PRINT

OBJECTS TO PRINT

Objects to print for the composting activity.

Key for composting activity

Compost

- Blueberries
- Banana Peel
- Applesauce
- Hamburger
- Chicken Tenders
- Carrots
- Half eaten PB&J
- Pizza
- Bread
- Orange peels
- Apple juice
- Apple core
- Salmon and Pasta
- Cookies
- Pretzels

Recycling

- Plastic water bottles
- Plastic applesauce container

Trash

- Fruit Rollup Package
- Starburst package
- Plastic sandwich bags
- Milk cartons
- Spork
- Fruit squeeze packs (packaging)
- Styrofoam tray
- Plastic wrap



OBJECTS TO PRINT



OBJECTS TO PRINT



OBJECTS TO PRINT



OBJECTS TO PRINT

