SB 1383: Pacific Grove's Adoption of Municipal Composting

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Abstract

Food waste is of ever-growing concern to the climate crisis, particularly in high-consumption societies. In the United States, between 30-40% of produced food is discarded as unused waste. This waste takes up landfill space, produces high levels of short-lived climate pollutants (SLCPs), and contributes to issues of food insecurity. California Senate Bill 1383 is a statewide mandate which goes into effect on January 1, 2022 and seeks to address these issues by reducing and redirecting organic waste. The primary goal is to reduce all organic waste by 75% as well as redirecting at least 20% of edible food to combat food insecurity, both by 2025. It also stipulates that any collected organic waste must be used either to produce products such as compost and mulch or for energy or biofuel production. For Pacific Grove and many other municipalities, this will be accomplished through the addition of a municipal composting program to the established waste management system. A majority of surveyed residents of the city cited either a desire for such a program or a lack of resources for at-home composting as barriers to reducing organic waste. This municipal program will address those concerns while meeting the requirements of SB 1383. To prepare for these changes, community education is vital. This includes making sure Pacific Grove residents are aware of these changes and have an understanding of their role in it, as well as implementing lessons to educate children in schools from grades K-12.

Introduction: The Problem of Food Waste

As the world's economies and populations grow, so does the global problem of food waste. Food waste is a global dilemma plaguing our modern society. Food waste is filling up our landfills which contributes to global climate change by producing greenhouse gases and short-lived climate pollutants. According to the EPA, landfills are the third largest source of methane emissions in the United States, just behind agriculture and industry (Levitan, 2013). Not only does food waste contribute to global warming but, due to the anaerobic digestion process, potential energy lost at landfill sites is very high. In a recent study from the Central European Journal of Engineering, calculations revealed that energy lost at landfill sites equals 43% of the delivered energy used for the preparation of foods in the US, 37% of the hydroelectric power generation of Japan, and more than 100% of the current annual renewable energy demand of UK industries (Melikoglu, 2013). Given that excessive food waste in landfills has detrimental effects such as methane and greenhouse gas emissions, it is clear that it is of importance to minimize the amount of food waste within landfills for the sake of climate justice. Yet, today the FDA approximates that 30-40 percent of the United States food supply is food waste. The FDA also reported for 2010 that 31% of food is lost at the retail level which is equivalent to 133 billion pounds and $161 billion worth of food (FDA, 2021). Due to these statistics, the federal government has put food waste diversion on the national agenda and assigned the task of reducing it to the USDA and EPA. However, achieving a sustainable and accessible form of disposing of global food waste is a contemporary challenge. It is one that has grown alongside overconsumption which will call for innovative solutions and efforts from local governments and municipalities.

Attitudes regarding waste in our modern society are often approached with consumerist views, where a product's “afterlife” does not come into thought. Waste is often tossed into a garbage can without a thought about where that item will go or what effects they will leave. It is an ‘out-of-sight, out-of-mind’ mentality. However, the rise of environmentalism and posthumanism has led to a growing awareness in society of the impact humans leave, particularly through awareness and education campaigns, and that translates to a new thinking about our waste and the infrastructure in place to deal with it. As people are becoming more aware of this issue, more and more households, businesses, and communities are taking up practices to divert their food waste from the landfills.

Composting

Composting is a sustainable waste management practice that has the potential, if utilized on a larger scale in the U.S., to vastly reduce food waste in landfills. Composting "involves the biological decomposition of organic matter," meaning that food waste can be broken down through natural processes and turned to a product that can be used for agricultural purposes (Epstein, 1997). There are many benefits on many levels to implementing composting infrastructure and systems including benefits to environment, agriculture, and economy. By breaking down organic matter through composting systems, a product is produced that can be used for soil improvements. Compost helps to minimize soil erosion, reduces irrigation, replenishes soil nutrients, and optimizes plant growth and health. Economically, municipal compost systems are much more cost effective than landfills and other more conventional waste systems by avoiding landfill fees and reducing transportation costs. Lastly, it benefits the environment by diverting food waste from landfills which in turn reduces greenhouse gas and short- lived climate pollutant emissions (WB, 2016). Composting uses a natural degradation process to reduce side effects of waste that disturb local ecosystems, such as production of methane and toxic leachate. This process is carbon neutral while being economically beneficial.

It is clear that there is a value to composting and that it should be expanded across global communities. The EPA states that 68% of municipal solid waste (MSW) is organic matter that can be composted, making it highly beneficial in reducing buildup of waste. However, implementing a municipal composting system poses a great many challenges, especially at larger scales (Epstein, 1997). Some of these challenges may include customer perception, quality assurance, legalities, or lack of public incentivization (WB, 2016). It is important for municipalities to identify the barriers and challenges associated with municipal composting within their area and attempt to build an efficient and accessible system to enable more widespread composting.

Implementing a municipal composting system has many benefits. It offers a solution to divert waste from landfills on a large scale. Additionally, it allows composting to be accessible for people when other factors may inhibit them from composting at home. Reasons could include: lack of space, limited knowledge of resources, limited time to set up a system, having a physical disability, or not having the financial resources. Municipal composting also creates profitable compost which can be sold. Due to the amount of space and the tools needed to set up a municipal composting system and facility, municipal composting requires collaboration between multiple cities as well as resources that may not be available. Because of the state laws requiring food waste diversion and short-lived climate pollutant reduction, all California cities are required to implement new waste reduction systems, many by the end of the year, which will require rapid change across the state.

SB 1383

SB 1383 is a statewide effort, signed by then Governor Jerry Brown in 2016, to reduce emissions caused by short-lived climate pollutants. The state aimed to reduce statewide disposal of organic waste by 50 percent by January 1, 2020 and aims to reach a reduction of 75 percent by January 1, 2025 while rescuing at least 20 percent of currently disposed of edible food, which will be made available for human consumption by 2025 (SB 1383, 2016). SB 1383 builds on California's existing commitments to reduce greenhouse gas emissions and air pollution statewide. Reductions of short-lived climate pollutant emissions are one of the state's five key climate change strategy pillars necessary to meet California's target goal. This policy also requires commercial edible food generators to recover the maximum amount of edible food possible -- food which would otherwise end up in the landfill -- to make it available for human consumption (SB 1383: State organics law, n.d.). Local governments would be required to consult with food recovery organizations and services to further ensure that there is the appropriate capacity to recover that food. Additionally, the food recovery groups would then be required to follow regulations in place for record keeping and reporting. The average cost increase to households is estimated at \$3 to \$5 per month, while the average increase to businesses is estimated at \$70 to \$90 per month (Jones, 2020). Many California cities have already developed updated organic recycling processing services and infrastructure that aligns with the goals outlined in SB 1383. Their successes, challenges and lessons can inform other cities working to implement SB 1383 regulations. By diverting organic material from landfills, the state can help reduce the dangerous impacts climate change has on weather, forests, homes, and ocean. Simultaneously, that food will feed people in need, power vehicles, and improve soil for agriculture.

Concerns

Concerns from individuals and households have not been gathered in a qualitative analysis but concerns for individual jurisdictions regarding compliance and enforcement are expected to be (SB 1383 Rulemaking Overview, 2018):

- Requires "high diversion processing" facility
- Demands (or requires) a standardization of colored containers that is not practical
- 75 percent in 2025 an unattainable goal
- Too prescriptive and punishment-focused
- Quarterly reporting within 30 days not feasible
- Requires significant staffing to track and implement process
- Methods are not science-based
- Requires multiple large, daily samples and analysis for each process, material type

Concerns are best addressed when a city/jurisdiction is able to review the draft of 1383 and submit comments to CalRecycle (SB 1383 Rulemaking Overview, 2018).

Pacific Grove Residents Survey

We created a survey to gain further insight into their perspective and experience about composting in the city of Pacific Grove. We asked 9 questions:

1) What is your zip code?
2) In an average week, what percentage of your trash bin is filled with food waste?
3) How much do you know about composting?
4) Do you currently compost?
5) Do you feel composting is beneficial?
6) If you don't compost, what is the biggest barrier preventing you from composting?
7) Prior to this survey were you aware of SB 1383?
8) How much do you know about short-lived climate pollutants (SLCPs)?
9) Questions/Concerns? (optional)

Survey Results

Question one “What is your zip code?” was created to ensure the participant was a Pacific Grove resident with the zip code 93950; any participant with a different zip code was excluded from the results. In total we had 67 responses, but 46 were Pacific Grove residents and the rest were either students we tested the survey questions out on or non-Pacific Grove residents.

For question two, “In an average week, what percentage of your trash bin is filled with food waste?” the participant had four choices: 0-25%, 26-50%, 51-75%, and 76-100%. The results showed 73.9% of participants said between 0-25% of their trash bin is filled with food waste, 17.4% of participants said 26-50% of their trash bin was filled with food waste, and 8.7% of participants said 57-75% of their trash bin was filled with food waste; no participants said 76-100% of their trash bin was filled with food waste. The results can be seen in **Figure I**.

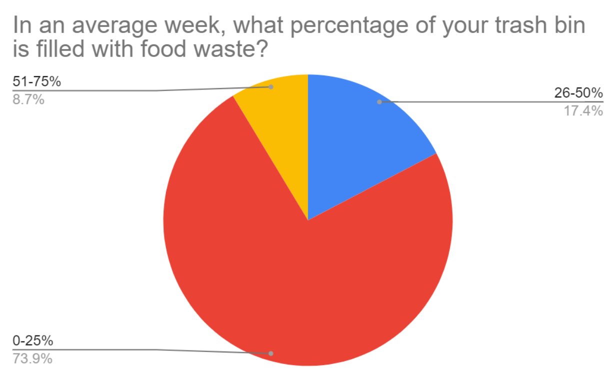

Figure I

Question three “How much do you know about composting?” the participant had five choices on a scale between 1-5:

1) What is compost?
2) I know what compost is, but I have never done it.
3) I have tried composting, just unsuccessfully.
4) I know how to compost.
5) I am an expert composter!

The results showed 0% didn’t know what compost is, 54.3% of participants stated that they know how to compost, 23.9% said they know what compost is, but have never done it. 17.4% of participants said they have tried composting, just unsuccessfully, and 4.3% stated they are an expert at composting. The results can be seen in **Figure II**.

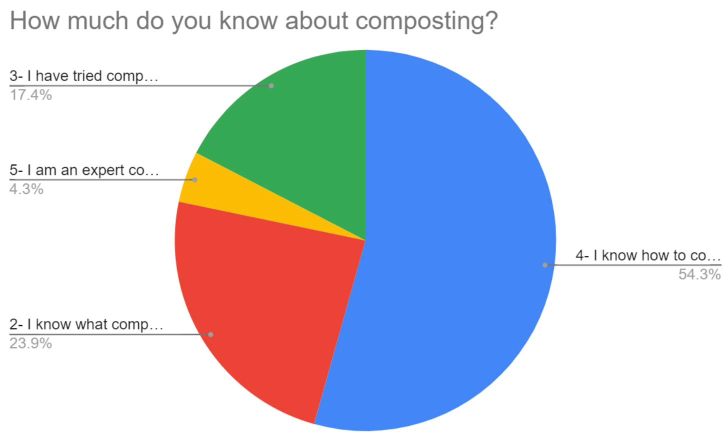

Figure II

Question four "Do you currently compost?" gave the participant two options to choose from: Yes or No. The results revealed 69.6% of participants don't current compost and only 30.4% do currently compost. Results can be seen in **Figure III**.

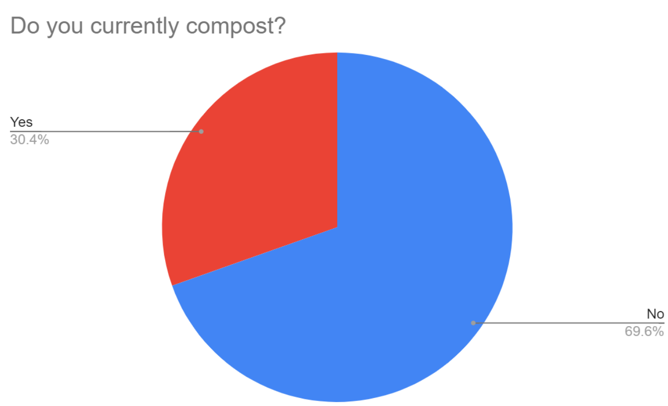

Figure III

Question five "Do you feel composting is beneficial?" gave the participant three options to choose from: Yes, No, and Not sure. The results showed 97.8% of participants do think composting is beneficial and 2.2% said they weren't sure if composting was beneficial; the results can be seen in **Figure IV**.

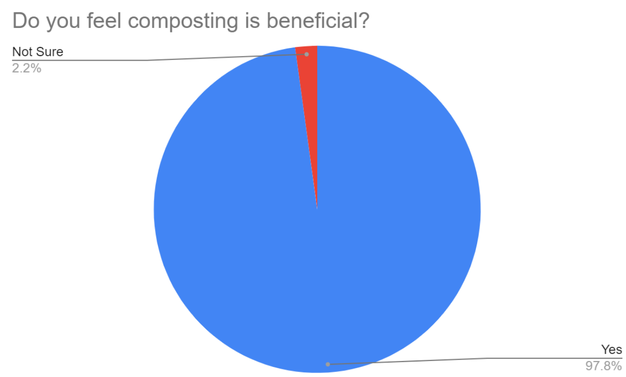

Figure IV

Question six “If you don't compost, what is the biggest barrier preventing you from composting?” For this question we switched from pie graphs to a bar graph to show the range of results more clearly. The results showed 14 participants stated they already compost, 10 said they didn’t compost due to the lack of city services for composting, 10 stated they don’t have the space to compost comfortably, 8 stated other reasons they don’t compost, 2 stated they don’t compost due to their lack of time, and 2 stated they don’t compost due to the smells. The Results can be seen in **Figure V**.

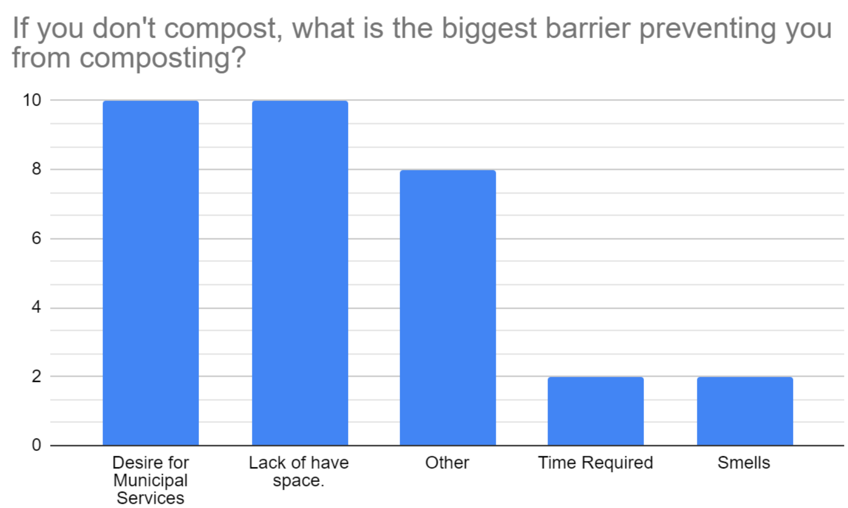

Figure V

Question seven asked “Prior to this survey were you aware of SB 1383?” and gave 2 options for the participant to choose from: Yes or No. The results showed 78.3% of participants were not aware of the legislation SB 1383 and 21.7% stated they were aware of SB 1383. The results can be seen in **Figure VI**.

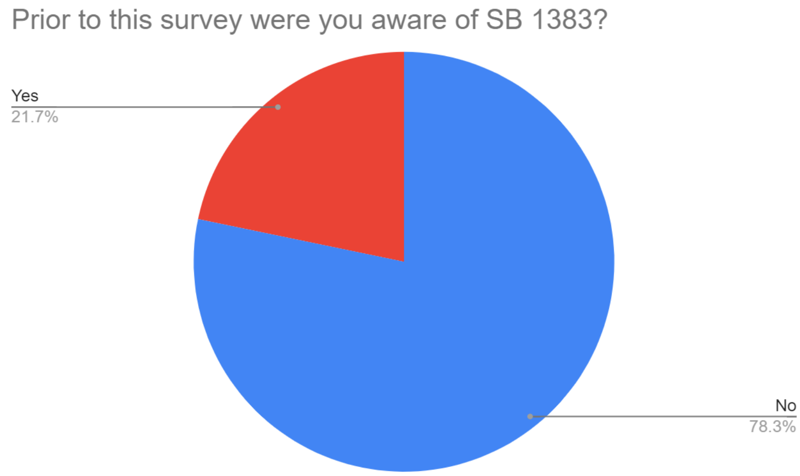

Figure VI

For question eight "How much do you know about short-lived climate pollutants (SLCPs)?" the participants had to choose a number on a Likert scale between 1-5 with 1 stating "What are SLCPs?" and 5 stating "I know all about them." For this question we switched from a pie chart to a bar graph to show the results of each value more clearly. The results showed that 21 participants didn't know what short lived climate pollutants were, 14 felt they knew a bit more about them, 6 participants felt they were in between and sort of knew but weren't confident. While 5 felt a bit more confident they knew what SLCPs were and only 2 felt confident saying they know all about SLCPs. The results can be seen in **Figure VII**.

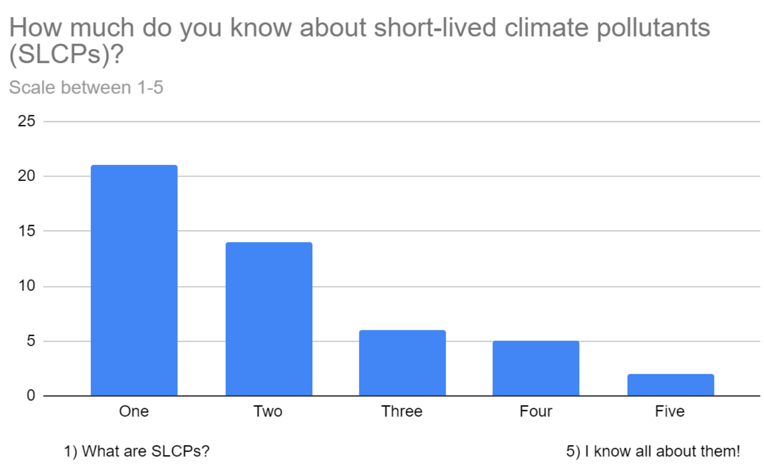

Figure VII

Question nine was optional and asked if the participants had any questions or concerns. 5 participants stated they would like Pacific Grove to provide more services to make composting more accessible and convenient, one participant was worried about the cost and the convenience. The rest of the participants opted not to answer.

Businesses and SB 1383

Commercial businesses, especially restaurants and markets that handle large amounts of food, will have their own measures to follow and accompanying concerns. For the most part, this system will function the same when disposing of non-edible food waste. Stricter measures will have to be taken in order to ensure non-compostable waste is not mixed in, but in general the practices will be the same as presently: separating trash, recycling, and food waste into bins for pickup. The biggest change comes from SB 1383's goal of 20% recovery of edible food by 2025. This means that restaurants, grocers, and other food handlers will have to be more conscious of monitoring their edible food, and setting aside any that will not be used for collection and inspection.

These requirements for the food recovery program will be implemented in two tiers over the next three years (CalRecycle). The first tier, which will include supermarkets and grocers as well as any food production or distribution facilities, goes into effect January 1, 2022. The second tier, which includes restaurants, cafeterias, and event spaces that serve food, goes into effect two years later, on January 1, 2024. This will require significant monitoring at multiple levels. Commercial businesses will require additional training so that their employees separate food and waste appropriately. The collection agency must closely inspect the food they recover and ensure it is fit for consumption. An oversight agency, most likely managed by the Chamber of Commerce for most municipalities, must be installed to ensure these other elements function properly and to monitor success towards the policy's goal.

Local Case Study: San Francisco

San Francisco, California is located in San Francisco County. This was chosen as a local case study due to the progressive history of this jurisdiction collecting organic waste in a three-receptacle program and because of the geographical proximity, sitting 115 miles north of Pacific Grove. Makeshift forms of high-volume recycling and San Francisco date back to the early 1900s and operated officially by two companies in 1920 (Journal of International Affairs [JIA], 2020). While California was setting goals and bills requiring communities to recycle 50 percent of their waste by 2000, San Francisco was beyond this scope. The city officially enacted a mandatory composting ordinance in 2009 (JIA, 2020). Recology, the service provider, operates the compost facility in Lamont, California. The company found importance in working with the community to understand its needs and concerns while adopting a program, the Good Neighbor Agreement, which promised that the company would directly hire within the community with the additional offer of stock ownership. Additionally, compost donations would be made to local gardens (JIA, 2020).

Local Case Study: Half Moon Bay

Half Moon Bay, California is located in San Mateo County, south of San Francisco. The city has a population of 12,870 and a land area of 6.42 square miles. There are 7,359 households with a median income of $111,000 (CalRecycle, 2020).

The 2018 organics waste pick-up case study was a mandatory case study and offered through a bundled rate to households. The hauling company received the full cost of service as a direct consumer to business transaction. The franchise hauler is Republic Services of San Mateo County (CalRecycle, 2020) and they supported a three-container system of waste pick up while transferring the recyclables and organics to be processed at Newby Island Resource Recovery Park in Milpitas.

The city found that the implemented diversion program was successful with a bundled rate structure and believes the success was due to a proactive approach in educating the public and elected officials of the need for raising rates to pay for the state-mandated services. Many subscribers saw a decrease in cost as their garbage cart size decreased from the trash diversion. The city believes that the success is due to customer knowledge, buy-in, and participation which included Republic to collaborate with the city in education, and start-up (CalRecycle, 2020). Verbiage will need to be updated in order to comply with SB 1383 language by 2024.

International Case Studies

In recent decades we have seen an insurgence of municipal composting across the globe. This shift has proven beneficial in reducing food waste and has reaped many benefits for many nations.

In 1999 the European Union (EU) set targets for waste diversion which required its member nations to make efforts in landfill diversion. The Landfill Directive required each member country to “reduce the biodegradable waste landfilled to 35% of 1995 levels by 2016, or 2020 for a selected group of countries” (WB, 2016). This incentive by the EU has shown to be very effective for many nations and the continent as a whole. Today in the EU, 40% of waste is composted or recycled. For Norway, Sweden, Germany, Switzerland, Belgium, Denmark, Austria, and the Netherlands, less than 3% of the nation's MSW is sent to landfills. Copenhagen, deemed one of the “greenest cities in the world,” completely stopped sending waste to landfills as early as 1990 (Levitan, 2013). Some reasons behind the success of these systems include the number of composting plants and their capacities, landfill fees and taxes, awareness campaigns, and education and outreach efforts.

In 2012 the city of Seoul, South Korea made an amazing achievement of diverting 100% of its food waste from landfills. This had been a few years in the making. In 1995 the government restricted the disposal of food waste and enacted a volume-based fee on waste. This incentivized the population to partake in composting. The city also invested into the development of compost treatment technologies as well in order to assure the quality of the compost. The developed nation of 10.5 million gives credit for their successes to effective legislation and their partnerships with NGOs, waste management districts, and urban farms (WB, 2016). What other municipalities could take away from the successes of Seoul is that in order to promote composting the city government must also phase out conventional means of waste management such as sending waste to landfills. It is important to disincentivize the community members to throw away organic matter that has potential to be composted.

Education, Solution, Implementation

One of the most essential aspects of implementing a municipal composting program is community education. The City of Pacific Grove recognized the importance of educating residents on the changes about to occur and remarked on the importance of children. Educating children is a great way to engage the broader community and even fight road blocks such as language barriers at home. Educating children can spark excitement and understanding throughout a community.

Lesson Plans

We created lesson plans for various grades for Pacific Grove teachers to adapt to their curriculum and teach their students about the importance of composting. Our lesson plan activities will vary for the different age ranges, and the teachers can adjust them further for their students' curriculum requirements. In the templates we created for the grade ranges, we have included the main goal "Students will learn that new laws are bringing composting to them, what that means, and what they can do. Waste can become soil. We can learn what to compost in our homes every day (this has a practical and important use)," main questions "What items can we put in a composting bin instead of a trash bin? Why is this important? What is something you can compost?," various activities, and listed the California Common Core Standard requirements that are met, for each grade level. We also provided debriefing questions such as "Why is composting important? Did any items that can be composted surprise you? What is something you can compost? What is something you thought could be composted but cannot be? What is something you want to learn more about composting?"

Grades 1st-3rd

For grades 1st through 3rd the lesson plan's main points are listed below:

- Main Goal: Students will learn that new laws are bringing composting to them, what that means, and what they can do. Waste can become soil. We can learn what to compost in our homes every day (this has a practical and important use).
- Main Questions:
    - Question 1: What items can we put in a composting bin instead of a trash bin?
    - Question 2: Why is this important?
    - Question 3: What is something you can compost?
- Activities:
    - Activity 1: Students can break into small groups or pairs. If they are experiencing in person learning: each group will receive different pieces of paper with various items on it as well as two bins. They will then decide if each item goes in the composting bin or the trash bin. Students can work together and learn just how many items can avoid the trash bin.

- Activity 2: If they are experiencing remote learning: teachers can use a powerpoint with a new slide for each item. They can call on students to answer which bin they believe the item would go in.
- Debriefing Questions:
  - Debriefing Question 1: Why is composting important?
  - Debriefing Question 2: Did any items that can be composted surprise you?
  - Debriefing Question 3: What is something you can compost?
  - Debriefing Question 4: What is something you thought could be composted but cannot be?
  - Debriefing Question 5: What is something you want to learn more about composting?

Grades 4th-6th

For grades 4th through 6th the lesson plan's main points are listed below:

- Main Goal: Students will learn that new laws are bringing composting to them, what that means, and what they can do. Waste can become soil. We can learn what to compost in our homes every day (this has a practical and important use).
- Main Questions:
  - Question 1: What items can we put in a composting bin instead of a trash bin?
  - Question 2: Why is this important?
  - Question 3: What is something you can compost?
- Activities:
  - Activity 1: Students can participate in a class-wide Kahoot quiz game to test their knowledge in a fun way.
  - Activity 2: Students could also choose an aspect about composting that they want to research further and present to the class or write a short paper on.
  - Activity 3: Ask students if they know what composting is and if they know anyone who composts. Then open the Compost Office Flash Interactive. Select "Why Compost?" and read aloud and discuss the contents.

- Activity 4: Do the same for "A Big Heap of Science" and "The Perfect Recipe."
- Activity 5: Next, tape your Composting Do's and Don'ts sheet on the board and read it aloud. Proceed with the following activities: Go around the room and ask each student what he or she had for lunch. List the food items as well as the food packaging, such as cans, plastic wrap, napkins, and so on. Go through the list, asking the students to decide whether each item can be composted or not.
- Activity 6: Finish by opening the "Can You Keep a Microbe Happy?" game, and play it with the students. As they go through the game, make sure they understand why watering and turning a compost heap are essential for decomposition to occur.

- Debriefing Questions:
  - Debriefing Question 1: Why is composting important?
  - Debriefing Question 2: Did any items that can be composted surprise you?
  - Debriefing Question 3: What is something you can compost?
  - Debriefing Question 4: What is something you thought could be composted but cannot be?
  - Debriefing Question 5: What is something you want to learn more about composting?

Grades 7th-9th

For grades 7th through 9th the lesson plan's main points are listed below:

- Main Goal: Students will learn that new laws are bringing composting to them, what that means, and what they can do. Waste can become soil. We can learn what to compost in our homes every day (this has a practical and important use).
- Main Questions:
  - Question 1: What items can we put in a composting bin instead of a trash bin?
  - Question 2: Why is this important?
  - Question 3: What is something you can compost?
- Activities:

- Activity 1: Students can participate in a class-wide Kahoot quiz game to test their knowledge in a fun way.
- Activity 2: Students could also choose an aspect about composting that they want to research further and present to the class or write a short paper on.
- Activity 3: Students can also watch the movie "Compost Everything: The Movie" and join gardening expert and author David The Good as he reveals the secrets to returning everything to the soil in this almost hour-long presentation.

- Debriefing Questions:
  - Debriefing Question 1: Why is composting important?
  - Debriefing Question 2: Did any items that can be composted surprise you?
  - Debriefing Question 3: What is something you can compost?
  - Debriefing Question 4: What is something you thought could be composted but cannot be?
  - Debriefing Question 5: What is something you want to learn more about composting?

Grades 10th-12th

For grades 10th through 12th the lesson plan's main points are listed below:

- Main Goal: Students will learn that new laws are bringing composting to them, what that means, and what they can do. Waste can become soil. We can learn what to compost in our homes every day (this has a practical and important use).
- Main Questions:
  - Question 1: What items can we put in a composting bin instead of a trash bin?
  - Question 2: Why is this important?
  - Question 3: What is something you can compost?
- Activities:
  - Activity 1: Students can participate in a classwide Kahoot quiz game to test their knowledge in a fun way.

    - Activity 2: Students could also choose an aspect about composting that they want to research further and present to the class or write a short paper on.
- Debriefing Questions:
    - Debriefing Question 1: Why is composting important?
    - Debriefing Question 2: Did any items that can be composted surprise you?
    - Debriefing Question 3: What is something you can compost?
    - Debriefing Question 4: What is something you thought could be composted but cannot be?
    - Debriefing Question 5: What is something you want to learn more about composting?

Additional Education Resources

These lesson plans are general guidelines for theoretical learning at different age ranges. However, when educating on habit-based topics like composting, a hands-on approach is often most effective. This gives a fuller understanding of how the process works, and contextual learning is vital to the information being retained (Berman, 2008). While not every school or other education program will have the resources to provide kinesthetic learning, there are often additional resources available to facilitate this style of learning.

For the city of Pacific Grove in particular, a good program for schools to utilize is provided by MEarth in Carmel Valley. This is a nonprofit organization attached to Carmel Middle School that focuses on teaching children sustainable gardening, composting, and cooking skills. Officially operating since 2008, they seek to promote engaged citizens through experience-based learning (MEarth, n.d.). They provide opportunities for field trips during the school day, after-school and weekend programs, and a variety of other programs for both children and adults. Using their 10-acre facility that mostly comprises an organic garden, students learn how to plant, tend to, harvest, cook with, and dispose of their own vegetables in an interactive environment. This shows them the entire cycle which ends in composting, and it is engaging while building important habits. This and similar programs could be beneficial to educating students on municipal composting efforts to adhere to SB 1383.

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World Bank. (2016). Sustainable financing and policy models for municipal composting. *Urban development series knowledge papers*. Climate & clean air coalition. http://documents1.worldbank.org/curated/en/529431489572977398/pdf/113487-WP-compostingnoweb-24-PUBLIC.pdf

Appendix

Grades 1st-3rd Lesson Plan

<table>
<tr><td colspan="2">Big Idea: Students will learn that new laws are bringing composting to them, what that means, and what they can do. Waste can become soil. We can learn what to compost in our homes every day (this has a practical and important use).

Guiding Question(s):
What items can we put in a composting bin instead of a trash bin? Why is this important? What is something you can compost?</td></tr>
<tr><td colspan="2">Standard(s):</td></tr>
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The students may have experience currently with recycling or have seen composting options at local restaurants. It could be beneficial to go over what counts as food waste. They can learn that putting this type of waste into composting keeps it out of landfills, makes soil, and helps the planet. Some students may already compost at home, some schools may have composting areas as well.</td></tr>
<tr><td>Experience or Task

Students can break into small groups or pairs. If they are experiencing in person learning: each group will receive different pieces of paper with various items on it as well as two bins. They will then decide if each item goes in the composting bin or the trash bin. Students can work together and learn just how many items can avoid the trash bin. If they are experiencing remote learning: teachers can use a powerpoint with a new slide for each item. They can call on students to answer which bin they believe the item would go in. After the activity, the class can have a discussion where each student suggests more items from home they can compost.</td><td>Materials or resources needed:

Cut out items, two small bins per group, online presentation</td></tr>
<tr><td colspan="2">Anticipating Struggles: Struggles that might arise and questions/moves to prompt thinking

It may seem confusing at first how this is different from recycling and why it is important. There may be varying levels of familiarity on the topic based on household norms. This will be a great opportunity for students with experience to help their classmates.</td></tr>
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Why is composting important? Did any items that can be composted surprise you? What is something you can compost? What is something you thought could be composted but cannot be?</td></tr>
</table>

Sample Google Slides Activity:

https://docs.google.com/presentation/d/1AqbVp9OyceJ8yvcJgUd6bWPPCvfPNx-OCKpB21D3yx4/edit?usp=sharing

Grades 4th- 6th Lesson Plan

Big Idea: Students will learn that new laws are bringing composting to them, what that means, and what they can do. Waste can become soil. We can learn what to compost in our homes every day (this has a practical and important use).

Guiding Question(s):
What items can we put in a composting bin instead of a trash bin? Why is this important? What is something you can compost?

Standard(s):

4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and 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.]

5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

MS-LS1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. [Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.] [Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.]

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.* [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).]

MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. [Clarification Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.]

MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. [Clarification Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.]

Launch: *Activate prior knowledge and set the context*

The students may have experience currently with recycling or have seen composting options at local restaurants. It could be beneficial to go over what counts as food waste. They can learn that putting this type of waste into composting keeps it out of landfills, makes soil, and helps the planet. Some students may already compost at home, some schools may have composting areas as well.

If in a policy class, you could go over the specific laws (ex. SB 1383); If in a chemistry class, you could go over topics such as the chemical process of decomposition; for an environmental science class, you could emphasize climate change (methane/ greenhouse gasses, carbon sinks/carbon sequestration, etc.)

Experience or Task	*Materials or resources needed:*
Students can participate in a classwide Kahoot quiz game to test their knowledge in a fun way. Students could also choose an aspect about composting that they want to research further and present to the class or write a short paper on.	Kahoot Quiz
Ask students if they know what composting is and if they know anyone who composts. Then open the Compost Office Flash Interactive. Select "Why Compost?" and read aloud and discuss the contents. Do the same for "A Big Heap of Science" and "The Perfect Recipe." Next, tape your Composting Do's and Don'ts sheet on the board and read it aloud. Proceed with the following activities: Go around the room and ask each student what he or she had for lunch. List the food items as well as the food packaging, such as cans, plastic wrap, napkins, and so on. Go through the list, asking the students to decide whether each item can be composted or not.	Compost Office Flash Interactive
Finish by opening the "Can You Keep a Microbe Happy?" game, and play it with the students. As they go through the game, make sure they understand why watering and turning a compost heap are essential for decomposition to occur.	Can You Keep a Microbe Happy Game

Anticipating Struggles: *Struggles that might arise and questions/moves to prompt thinking*

It may seem confusing at first how this is different from recycling and why it is important. There may be varying levels of familiarity on the topic based on household norms. This will be a great opportunity for students with experience to help their classmates.

Debrief Questions: *Include assessing and connecting questions*

Why is composting important? Did any items that can be composted surprise you? What is something you can compost? What is something you thought could be composted but cannot be? What is something you want to learn more about composting?

Some related Kahoots to play as a class:

https://create.kahoot.it/share/composting-basics/19cd216b-d4f0-445f-bb03-9e121d2f3415

https://create.kahoot.it/share/composting/c8f35afa-8e35-4877-b965-f743812f5f1d https://create.kahoot.it/share/composting/9317c8db-41b2-427b-861f-68afe117981f

Grades 7th-9th Lesson Plan

Big Idea: Students will learn that new laws are bringing composting to them, what that means, and what they can do. Waste can become soil. We can learn what to compost in our homes every day (this has a practical and important use).

Guiding Question(s): What items can we put in a composting bin instead of a trash bin? Why is this important? What is something you can compost?

Standard(s):

MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. [Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).]

MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. [Clarification Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts).]

MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. [Clarification Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.]

MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. [Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.] [Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.]

HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.* [Clarification Statement: Examples of human activities can include urbanization, building dams, and dissemination of invasive species.]

HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. [Clarification Statement: Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.]

HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.* [Clarification Statement: Emphasis is on designing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.]

HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth's systems. [Clarification Statement: Examples should include climate feedbacks, such as how an increase in greenhouse gases causes a rise in global temperatures that melts glacial ice, which reduces the amount of sunlight reflected from Earth's surface, increasing surface temperatures and further reducing the amount of ice. Examples could also be taken from other system interactions, such as how the loss of ground vegetation causes an increase in water runoff and soil erosion; how dammed rivers increase groundwater recharge, decrease sediment transport, and increase coastal erosion; or how the loss of wetlands causes a decrease in local humidity that further reduces the wetland extent.]

HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. [Clarification Statement: Examples of the causes of climate change differ by timescale, over 1-10 years: large volcanic eruption, ocean circulation; 10-100s of years: changes in human activity, ocean circulation, solar output; 10-100s of thousands of years: changes to Earth's orbit and the orientation of its axis; and 10-100s of millions of years: long-term changes in atmospheric composition.] [Assessment Boundary: Assessment of the results of changes in climate is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution.]

HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. [Clarification Statement: **The carbon cycle is a property of the Earth system that arises from interactions among the hydrosphere, atmosphere, geosphere, and biosphere. Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.]

Launch: *Activate prior knowledge and set the context*

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If in a policy class, you could go over the specific laws (ex. SB 1383); If in a chemistry class, you could go over topics such as the chemical process of decomposition; for an environmental science class, you could emphasize climate change (methane/ greenhouse gasses, carbon sinks/carbon sequestration, etc.)

Experience or Task	*Materials or resources needed:*
Students can participate in a classwide Kahoot quiz game to test their knowledge in a fun way. Students could also choose an aspect about composting that they want to research further and present to the class or write a short paper on.	Kahoot Quiz
Students can also watch the movie "Compost Everything: The Movie"and join gardening expert and author David The Good as he reveals the secrets to returning everything to the soil in this almost hour-long presentation. If you're tired of turning piles, keeping away rodents, trying to get your C/N ratios correct and looking for the perfect composting bin... it's time to quit worrying and start composting the way NATURE composts!	Compost Everything: The Movie

Anticipating Struggles: *Struggles that might arise and questions/moves to prompt thinking*

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Grades 10th-12th Lesson Plan

Big Idea: Students will learn that new laws are bringing composting to them, what that means, and what they can do. Waste can become soil. We can learn what to compost in our homes every day (this has a practical and important use).

Guiding Question(s):
What items can we put in a composting bin instead of a trash bin? Why is this important? What is something you can compost?

Standard(s):

Launch: *Activate prior knowledge and set the context*

The students may have experience currently with recycling or have seen composting options at local restaurants. It could be beneficial to go over what counts as food waste. They can learn that putting this type of waste into composting keeps it out of landfills, makes soil, and helps the planet. Some students may already compost at home, some schools may have composting areas as well.

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Experience or Task	*Materials or resources needed:*
Students can participate in a classwide Kahoot quiz game to test their knowledge in a fun way. Students could also choose an aspect about composting that they want to research further and present to the class or write a short paper on.	kahoot quiz

Anticipating Struggles: *Struggles that might arise and questions/moves to prompt thinking*

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Why is composting important? Did any items that can be composted surprise you? What is something you can compost? What is something you thought could be composted but cannot be? What is something you want to learn more about composting?

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