Food Waste and Behavior Change Through Project-Based Learning

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FOOD WASTE AND BEHAVIOR CHANGE THROUGH PROJECT BASED LEARNING

By Patrick Crawford

A capstone submitted in partial fulfillment of the requirements for the degree of Master of Arts in Education.

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The Food Waste Issue

Food is humanity's closest intact connection with the natural world. Eating is literally taking part of the natural world and making it part of ourselves and we eat everyday. Thinking about food and the act of eating in this intimate way is what raised the question of why we waste so much of our food. In 2011 food waste was approximately 4.1 billion for the United States. Manufacturing caused 2.4 billion pounds of waste and 1.7 billion was lost to retail and wholesale (Analysis of U.S. Food Waste Among Food Manufacturers, Retailers, and Wholesalers, 2013). These numbers do not include the amount of food that is lost within individual households, but the numbers are still quite shocking. When I saw these numbers I immediately blamed industry and retail practices. What can I do? How could I make a difference in these numbers as an individual consumer? After much reflection I thought education could hold part of the answer.

I have been teaching students aged between 11-14 in an urban setting for five years. Again, questions came to mind, mainly how do I change the mindset of the most apathetic, self-serving age group? This statement is not intended to be demeaning toward this age group but nearly any teacher or professional that works with students of this age range knows that in the mind of these young teenagers, the world revolves around them.
People that work with this age group also know that in every facet these young adults are the most apt to change ideologies and behaviors. This makes middle school students the most difficult, and yet the most “sculpt-able” age group.

Seeing these shocking numbers and realizing that I could perhaps make a difference in this age group led me to ask more questions on food waste and how individuals can really make a difference.

**Humans, Food and the Environment**

Food is the number three necessity that all humans need to survive, following air and water, respectively. If the United States alone is wasting 4.1 billion pounds of food per year due to retail and manufacturing alone, the worldwide number must be staggering in comparison. People around the world are starving and we are wasting billions pounds of food yearly. Using the FFA (Future Farmers of America) estimate that 1.2 lbs. of food equals one meal, we can conduct a quick math exercise. Using this estimate we are wasting 3.4 billion possible meals for human consumption. Let’s assume three meals a day for the population of India, which was 1.2 billion in 2011. Let’s also assume a small family size of three, which would mean 4 million families within India. The United States has 3.4 billion possible meals wasted yearly and this could feed the entire country of India for 850 days (which is 3.3 years). I could continue to run these numbers but I chose one of the largest food wasters and one of the largest world populations to illustrate that reducing our food waste is incredibly important not just to the natural world, but also to the human race. Using these estimates, if we were to keep 100 percent of our food
waste domestically and use it toward the United States population, we could feed everyone in the United States for 1100 days (or 4.2 years). These numbers are just to illustrate the vast amount of food wasted within the United States every year.

It is important to keep in mind that manufacturers and retailers do not just throw out 4.2 billion pounds of food yearly. Factors such as spoilage, transportation damage, and preparation for consumption need to be considered. Food goes bad and when the food spoils it is disposed of there is no getting around this issue. When the food spoils it is disposed of. The real question is, what factors cause these retailers and manufacturers to classify food as spoiled? The manufactures often need to dispose of food that is considered imperfect as opposed to actually spoiled because retailers has created consumers that have come to expect a certain shape or color for certain foods. In retail, a potato is a brown oval, but any trip to a farmers market in late summer can disprove this expectation. A carrot is long, conical and orange; any gardener will tell you that many carrots do not come out the ground this shape. The consumer’s expectation of what food “should” look like drives much of the food waste for manufactures.

Transportation damage and spoilage are much more subjective at the retail level of food waste. If the produce team sees food that they do not think will sell the items are simply thrown in the trash. Fruits that may have been slightly bruised during transportation to the retailer are also discarded, even if only one piece of fruit in a plastic container is damaged. (Personal reference; working at Target cooperation for seven years I have observed this happen and know the procedures for retail food waste).
Manufacturers and retailers are not entirely to blame for our food waste. Every action that these entities make is based on profit and what consumers buy. If we are able to change our buying habits and perceptions of what we think food should look like, this would allow these entities to change their practices without losing profit. Granted, changing the ideology of an entire population ideology is difficult without large-scale intervention, but small changes on the local level can also affect local consumer habits. This is a grassroots mentality of change.

I would also like to note that no matter how much we change ideologies and consumer habits, food waste is an inescapable occurrence. Gardeners and local farmers still have food waste. If the food is partly eaten by insects or herbivorous animals the rest of the food is often discarded because of contamination. Although it is also important to consider what we do with food waste if animals of insects are eating produce in my garden, I usually do not completely discard the produce but instead compost what is not eatable. This allows natural processes to deconstruct the food and create a product, compost, which is usable as fertilizer for future crops. This is something that many gardeners do but is often overlooked by manufacturers and retailers due to the cost of upkeep and quantity of food waste. Again, if this is something that the consumer values businesses will change their practices to meet demand to make profit. The conclusion from this standpoint is that while it is impossible to produce food without food waste, thinking about what we do with the waste and being conscious consumers can dramatically decrease the level of food waste being produced.
Passive Behavior Change

How do we make this change? As mentioned above, grassroots mentality is necessary to make a reasonable change. If a governing body tells people what to do it seems like our freedom is being impeded. But at the same time can making a change passively change behavior without making people feel oppressed? What I mean is that the best way to make a long-term behavior and ideological change is to make the person feel as if they have made the decision themselves instead of telling them how to behave. This is a form of manipulation, but in my opinion, for the right reasons.

Research indicates that people will oppose things they are told to do but are much more receptive to change in behavior if they feel as if they made the decision themselves (this will be discussed at length in the review of literature portion of the paper). Drawing from this research, a level of purposeful, passive manipulation is important to change habits of people. There are only a small percentage of people that either strongly oppose change or strongly support change. Most people may oppose, support, or abstain from environmental ideologies, but are willing to change if incentives or motivators are in place. One example of this is recycling. 30 years ago, recycling was only something that environmentalists did and something happened to change the mentality of the majority of people to believe that it is not only the right thing to do, but a thing you just do. Environmentalists don’t need to convince people that recycling is a positive behavior, because it has transformed into a behavior that is more or less engrained into our everyday lives. There are some key components that make recycling an everyday behavior. It is easy, cheap, and feels good. It is made easy because now households and
kitchens are equipped or very easy to equip with a recycle bin. People get the benefit of taking the trash out less. Easy. Recycling is either inexpensive or free to have picked up and can save the consumer money by not having a large trash bin pickup. In my opinion the most important key to why it works is because it makes people feel good. You feel as if you are helping the environment and your community by not producing as much trash. This feeling is something that is deeply ingrained in us now, which is what makes this behavior an everyday event. The other end of this is tricky. The fact that we recycle and feel as if we are helping the environment on a daily basis has created a mentality that we’re ahead on the scale of taking care of the environment and can do whatever we want. Even recycling centers are being overloaded with recyclable materials and have trouble keeping up with the supply. Even though there are a few downsides to large scale recycling, the change in people’s behavior is very evident.

The change of ideology toward recycling was not made by top-heavy legislation, but by communities that felt it was important until it grew into a complete ideological shift in thinking. This is what needs to be done with food waste. We cannot force people to change their habits, but instead we need to shift their ideologies and behaviors will follow. Recently there has been a large compost movement and now most major retailers have kitchen sized compost bins or large outdoor red worm compost bins. This is a great place to start, but is not changing the amount of waste produced in households it is simply changing what we do with the waste. My goal is to change the behavior that leads to food waste not the behaviors of deciding what to do with food waste.
My Personal Journey with Food

Like most journeys, mine started as a child. In my early childhood, my mom was a passionate gardener. As a kid, I hated helping with the weeds and the garden work but always enjoyed being outside. Seeing the things that the earth produced at an early age in the garden with my mom helped to shape my ideas about the world even though I did not realize it at this time.

When I hit the age of 12 my parents separated and eventually got divorced which changed my worldview dramatically. My mother left my dad to work full time and raise both my sister and me. At this point my idealism, innocence and childhood came to an end. I was now the person that had to take care of my sister and the house while my dad was working. We all worked together to make it work, but the food in the house changed. My father can cook and enjoyed cooking, but with the way schedules worked many dinners were fast and easy, and things that I could also prepare if he was not there. I have very fond memories of hotdogs and mac and cheese. Home cooked meals from scratch became a special occasion. The one thing that allowed me hold onto my ideals was our dinnertime ritual where we would sit at the table as a family of three and eat together even though it seemed forced at the time. Time passed and my food habits did not change much through high school, but I am grateful to my mother who showed me the connection of food to the earth and my father that taught me the importance of eating together.

My two years in community college went by fast, but living with three of my high school friends made me realize how much I really knew about cooking. Even though
food on a budget is usually highly processed food, one of my roommates and I were the chefs of the apartment. Fresh produce was a special occasion because at this point in my life I did not understand the importance of real food. All of this changed when I took an environmental biology class my sophomore year of college.

Confused and lost in what I wanted to do with my life I jumped from one major to another, from budding engineer to comic book store entrepreneur back to “I have no idea.” I walked into environmental biology, which I was just taking to fulfill my requirements; little did I know that this would light a spark inside of me that was long dormant. The teacher made me feel as if I could make a difference in the world through environmentalism, but being a good capitalist I realized that I wanted to make a difference and still make a living. After many compelling conversations with myself, I decided to pursue education. Teaching would be my tool to help the environment. I had learned so much about myself and the world through this one class, maybe I could do the same for the next generation.

I went on to spend three years at Hamline University working toward an education minor along with a bachelors in biology. Through close friends and my wonderful to-be-wife, I realized that a major problem that not only effects the environment but the world is overconsumption. I became very passionate about consuming less and becoming aware of what I was consuming. The realization that I vote every time I buy a product changed my worldview. Now farmers markets, co-ops and Whole Foods became weekly outings. These decisions pushed me into becoming a self-taught cook. I also began reading non-fiction books, which I never read voluntarily,
but I was actually enjoying reading about food ethics and making the food production process more transparent. This passion led me to my masters program at Hamline, once again, in environmental education, but this time my ideology was clear and I knew that I could make a difference with the next generation.

The biggest obstacle I face is how do I teach my 12-year-old self about the importance of the environment? Teaching 6th grade students for five years has shown me the biggest hurdle is the pre-teen hubris. To overcome this, I need to find something that is meaningful and real to the students and show them how they can make a real difference in their corner of the world.

Food Waste and Consumption

I had mentioned previously that my passion is stemmed in the human need to consume. Homo sapiens consume huge amounts of the world’s resources, and much of what we consume is just lost or wasted. Teaching the next generation to consume less will improve the human condition and the world at large. How I learned about the importance of knowing what we are consuming is through reading and learning about food. We as humans need food to survive. So, why do we take our food for granted or overlook knowing about how it is produced? Michael Pollen, food advocate and author, taught me through making the food system transparent. In his book *Omnivores Dilemma*, he removes the veil that has been put over our eyes about how food is produced. He mentions that if slaughterhouses had glass walls, many more people would eat less meat. This is not an avocation for vegetarianism, but a call for transparency to allow people to
make up their own minds about what they are consuming when presented with all the facts. The omnivores dilemma is not what to eat, because as omnivores we can eat almost anything, but the dilemma is what should we eat. This idea changed the way I personally looked at food and, in turn, how I looked at the world.

What I find interesting is that Americans have huge amounts of food at their fingertips, but much of this food is discarded or sent to garbage dumps. Food waste may be a huge issue, but changing how we view consumption and making our actions transparent can lead to real change.

Passively Teaching Behavior Change

Behavior change is not something that you can just tell a person to do, especially youth who have always been known for rebellion. However, behavior change can happen through education. The key is to understand the rebellious nature of the youth, while still understanding that they have family traditions and boundaries that are ingrained within them. This leads to the idea that I will refer to as passive behavior change through teaching.

Education can change behaviors, but the teacher needs to allow the students to form their own ideas, or at least make them feel like they are forming their own ideas. This is a level of manipulation, but it is important to always allow the students to reject the ideas presented. If they do not have a choice to reject or accept the idea, in my experience, students will then overwhelmingly reject the idea simply because the teacher did not allow for choice. The job of the teacher is to guide students to make their own
decision based on the information available. This approach will get most students to accept the idea presented to them.

**Teaching Through Project Based Learning**

I teach middle school science and this lends itself to more hands-on learning than many other subjects within education. This being said, all subjects benefit from creating projects that allow for the students to learn on their own. Based on my experience as a teacher, many conversations and observations of other teachers, and scientific research project-based learning is one of the best ways to teach students. The biggest issue that pushes against project-based learning is the number of standards, time, and resources available to teachers. Teachers are required to teach the state standards to students and this pressures many teachers to steer away from projects just due to time constraints. The other major issue is the availability of resources. Teachers often pay for materials out-of-pocket and they can only afford to do this a few times a year to make meaningful projects for students. As a science teacher, I do have more funds available for resources than many other teachers. This allows me to create projects that give students the opportunity to learn on their own.

Projects tend to create long-term retention in students because they are learning by doing, which is a form of kinesthetic learning or motor memory and leads to a much longer-term memory than auditory or visual learning. Basically, if a student does something they will remember it. If time is taken to create a project that is meaningful
and has a purpose, a teacher can create a long-term memory and maybe even elicit a behavior change in the student that could last a lifetime.

Research Question

The focus of my research will be,

“Food Waste and Behavior Change, though Project-Based Learning.”

In the next chapter I will defend my proposed study by diving deep into research in three main areas: food waste, psychology of behavior change, and advantages of project-based learning.

Brief rational for research,

1) Food Waste, show importance of the issue and how the affluent countries waste the most food on the consumer level.

2) Psychology of behavior change, methods of changing behavior and how to effectively elicit behavior change in a group of people.

3) Project-based learning, actionable levels of change in food waste, and effectiveness of project based learning in retention of knowledge.

The research will focus on what is the issue and why it is important, how can we change the behavior of people in a real way, and implementation of action teachers can take.
CHAPTER TWO

LITERATURE REVIEW

Introduction

Parfitt, Barthel and Macnoughton (2010) incorporated many different pieces of research to get a comprehensive view of the worldwide food waste issue. The primary focus of this research will focus on this paper, but other resources were used to attain a full view of the research done by Parfitt et al. As discussed in chapter one, food waste is a huge issue that could feed millions of people if we changed how we view waste. There are three major trends that will be explored for which food waste data provides a clear image.

1: The difference between food waste within developing countries and industrialized countries.

2: Food loss is highest at the post-consumer level.

3: Difficulty in defining post-consumer food waste.

The final part of this section will be focused on how we can fix the global trends of food waste.

Food Waste Within Developing Countries and Industrialized Countries

The overall trend is that industrialized countries waste much larger quantities of food than developing countries. This may seem counter-intuitive because the industrialized countries have access to many more methods of storing the food and keeping the food cold throughout the transport process. This is taken into account, but
the factor that is often overlooked is the dietary transition. Developing countries tend to eat more starches and easy to store food, this produces very little waste, because staple grains are easy to store and transport. Whereas industrialized countries eat larger quantities of perishable foods, like salads and fruits. This is clearly illustrated in the graph below taken from Parfitt et al 2010.

Figure 1 – Food waste is divided into categories measured in millions of tons per year. Dark brown represents avoidable food waste, yellow is possibly avoidable, and blue is unavoidable food waste. (Parfitt 2010 pg. 3076)

Figure 1, clearly shows that the more perishable the food is the higher level of food waste. This trend makes sense because highly processed or “staple foods” (grains etc.) are easy to store and have a very low spoilage rate. Industrialized countries have the infrastructure to produce and transport perishable foods, but even with the technology of
cold transport nearly 1.75 million tons of fresh fruit and salad are wasted per year.

Industrialized countries produce most of this food waste due to the dietary transition away from staple foods. Whereas developing countries have not transitioned their diet away from the easily stored staple foods, and therefore produce less waste.

There may be other cultural reasons as to why industrialized countries waste more food than developing countries, but little research has been done on this and is very qualitative and subjective in nature. The major trend that I would like to focus on is that industrialized countries produce significantly more food waste than developing countries.

**Food Loss at the Post-Consumer Level**

Food is wasted, or lost, throughout the whole process of ground to plate. This process has many steps where food is lost or wasted. Pests and insects can and do make some food inedible. Food can be damaged during harvest, or post harvest. Food is selected based on what retailers will pay for, and some imperfect food is wasted. Food is also lost during transport to retail. Once in the retail environment the food can succumb to spoilage or fail to be sold prior to the “purchase by” date. The retailer will then dispose of this food. All of these points of loss from ground to plate could be added together and still not compare to the amount of food waste produced in the post-consumer phase. The post-consumer phase is when the food is purchased and is out of the retail system. The graphic below (Parfitt 2010) shows the pathways into homes and disposal of food waste within the home.
Figure 2 – Illustrates the pathways that food waste follows from pre-consumer to post-consumer. (Parfitt 2010 pg. 3073)

These pathways are focused on homes within the UK but still illustrates an industrialized countries disposal methods. To further illustrate the amount of food waste at the post consumer phase, figure 3 (Parfitt 2010) shows the dramatic difference in wasted food in the manufacturing and retail phases versus waste within the household.
**Figure 3** – The amount of food waste divided into four categories and subdivided into recovery/reuse and disposal. The light purple bars show the amount recovery/reuse food waste and the magenta bars show the amount of food waste that was sent to disposal measured in metric tons. (Parfitt 2010 pg. 3072)

The major trend within this data is that the vast majority of food waste is produced in the post-consumer phase within the ground to plate spectrum.

**Difficulty Defining Post-Consumer Food Waste**

There is not a consensus on how to define food waste and this leads to issues in collecting data. The two major definitions have one major theme in common; food waste is only edible food that is discarded. (FAO 1981, Stuart 2009). This means that food that has been eaten by pests during harvest is not included only edible food that is lost in the process of ground to plate. The definition by Stuart 2009, also includes food that is “intentionally diverted” from human consumption to feed animals. These definitions are widely accepted as a large-scale view of how to measure food waste, but things can get convoluted at the post-consumer level that may skew the data up or down depending on the researcher. For instance, in the Parfitt 2010 research they found that the UK, US, and other countries all measure food waste differently, but all countries still found that the most food waste was produced at the post-consumer level.

Often to measure post-consumer food waste the amount of biological waste is measured at the landfill and averaged. This is a very imperial method and can get close
to the actual number, but ignores other biological waste that is thrown out in homes, and reuse of food waste at homes such as compost or other methods used to dispose of food waste in a residential setting. Should we be looking at reuse numbers to subtract from the other food waste, or at least include the reuse of food waste numbers to provide a clearer picture of what can be done to change this trend?

What Can We Do

Where can the most meaningful change happen? Looking at the trends outlined above, the most food waste comes from the post-consumer phase because industrialized countries have an infrastructure that allows for cold transport of food and reduces spoilage significantly. As we move into the future, more and more countries will transition from developing to industrialized. Because of the amount of waste produced by individuals in industrialized countries, this would predict an increase in food waste worldwide unless something changes. This means the place to make the biggest difference in the quantity of food waste is in the post-consumer sector.

Making a change in the post-consumer sector of food waste is difficult because this involves individual people and families, not businesses that are focused on profit (a very strong motivator to not waste your assets). When dealing with individuals, habits are formed and ideologies on food waste are cemented, which is a difficult hurdle to jump to make a change. This will be the focus of the next section of research, the psychology of behavior change.
The most meaningful change happens with the consumer, and the consumer that is most open to change is the youth. Education is a key component to changing how much food we waste, but is rarely discussed within the education system.

“The greatest potential for the reduction of food waste in the developed world lies with retailers, food services and consumers. Cultural shifts in the ways consumers value food, stimulated via education, increased awareness of the FCS and food waste’s impact on the environment have the potential to reduce waste production.” (Parffit 2010 pg. 3079)

Education is a major key to changing the future of food waste, and will be the focus of section three of chapter 2.

Psychology of Behavior Change

There are many differing views on what can actually cause a lasting behavior change in people. Coupled with the complexity of changing behavior toward environmentalism, this becomes a very difficult thing to predict. Predicting environmental behavior changes are difficult because there are so many differing definitions, strategies, barriers, and types of environmental behavior change to take into account. These are the four major topics that I will be researching to find the best mechanism to illicit behavior change.
Defining Environmental Behavior

To define what environmental behavior is I will take 2 major definitions generated by Paul Stern. Definition one, “the extent to which changes the availability of materials or energy from the environment or alters the structure and dynamics of ecosystems or the biosphere itself. Some behavior, such as clearing forests or disposing of household waste, directly or proximally causes environmental change.” (Stern, 2000). This definition I will refer to as the direct impact definition, because this is defining how human behavior directly impacts the environment. Definition two, “Other behavior is environmentally significant indirectly, by shaping the context in which choices are made that directly cause environmental change. For example, behaviors that affect international development policies, commodity prices on world markets, and national environmental and tax policies can have greater environmental impact indirectly than behaviors that directly change the environment.” (Stern, 2000). This definition I will refer to as the indirect impact definition.

Using these definitions of what environmental behavior is, within my study we will focus on the direct impact definition. Not only is disposing of household waste included as an example, but also wasting food is an environmental behavior that directly effects the environment. There are indirect effects of wasting food, but the majority of impact is humans directly choosing their behavior to waste food. For the sake of this section of research, I will be using the direct impact definition to guide the thinking for the following sections.
Types of Environmental Behavior

There are four major types of “environmentally significant behaviors” identified by Paul Stern in the paper Toward a Coherent Theory of Environmentally Significant Behavior; Environmental activism, Nonactivist Behaviors in the Public Sphere, Private-Sphere Environmentalism, and other environmental behaviors (Stern, 2000). It is important to distinguish the type of behaviors to help identify which behavior I will be focusing on with food waste.

*Environmental Activism:* This behavior is when a person is consciously trying to engage the public or raise awareness of environmental issues through taking action.

*Nonactivist behaviors in the public sphere:* This is different from activism because the behaviors are not raising awareness or making change through action. Instead the behaviors include things like changing public policy through voting or petitioning, or even donating money to environmental action groups.

*Private Sphere environmentalism:* This behavior is when a person acts environmentally, but only within their private homes and/or decisions made in what they consume. Examples of this behavior are purchasing environmentally friendly cleaning supplies or energy star appliances, making environmentally conscious decisions on how to eliminate household waste.

*Other environmentally significant behaviors:* The last type of behavior category is making changes on large-scale projects through organizations or
manufacturing. This includes behaviors such as designing LEED certified buildings or convincing business boards to use environmentally friendly behavior.

What leads people to these types of behaviors? There is a theory that states that values lead to beliefs, leading to norms within your life, which finally leads to behaviors (Stern, 2000).

Figure 4 – Pathways to behavior change moving from values to beliefs to personal norms, which flow into pro-environmental behaviors. (Stern, 2000 pg. 412)

Figure 4, is a basic outline that shows the major ideas of how a person would get to a behavior without purposeful intervention to generate a behavior change. The three values biospheric, altruistic, and egoistic that one develops throughout life are the strongest factors to shape a person’s ecological worldview. Once that belief is formed the consequences of the belief on everyday life are considered. Once this is formed, the decision of if one has the ability to change or reduce the threat is made or the question of how much control there is over the consequences is considered. Lastly, the sense of obligation to the environment will shape which behavior pattern listed above will be
Within this structure, and types of behavior change, food waste behavior fits closest within private sphere environmentalism. Food waste is a symptom of people making decisions within their personal lives and within their personal means to waste food. The next question is where can we make a difference if we are trying to change behavior? If we are using Fig 4 from Stern 2000, this is very limiting to where change can happen. The place where the most behavioral change would happen is within the personal norms. Changing personal norms is complex and very dependent on the person that you are focusing on. The VBN (value belief norm) model does a good job of outlining the process of how we arrive at the behavior, but little to explain how change can happen and what factors are involved with long term change.

Figure 5 – A Model of pro-environmental behavior illustrating the complex
pathways to reach pro-environmental behavior. (Kollmuss & Agyeman 2002 pg. 257).

Figure 5, taken from Kollmuss 2002, demonstrates the complexity of environmental behavior change. This model takes into account many variables that Stern’s overview does not. One of the major additions to the model is knowledge; for if one does not have enough knowledge on the issue a change cannot be made. But knowledge is not the only factor to take into account, all the black boxes shown in Figure 5 are barriers to behavior change, which will be examined later on. Both Stern’s model and Kollmuss’ model serve similar but still different purposes, and both are effective at conveying the points they aim to display.

Even if we can identify what type of environmental behavior food waste is the complex issue of how to change the behavior toward pro-environmentalism still exists.

Strategies for Behavior Change

Gardner and Stern (1996) identified four methods of changing behavior toward pro-environmentalism. These mechanisms are ways people change world-views. The first mechanism is changing values through religious and moral approaches. This approach looks at the morality of a person, often based in religious background, and uses this information to show how pro-environmental worldviews and the individual’s worldviews overlap. Showing a commonality between what a person already believes and pro-environmental beliefs is a deep-rooted method of change. The second
mechanism for change is education. This method simply means that if a person is more knowledgeable about the topic and given opportunities to discover information on their own this will elicit a behavior change in that person. Mechanism three is “material incentive.” This incentivizes the pro-environmental behavior by giving rewards or penalties for anti-environmental behavior. An example of this would be getting a discount on your energy bill for installing more energy efficient equipment in a house. Lastly, “community management” can change behavior to more pro-environmental. These could be community agreements on conduct or expectations. This is using peer pressure to change behavior. With these in mind, Stern discovered, that, “moral and educational approaches have generally disappointing track records, and even incentive- and community-based approaches rarely produce much change on their own. By far, the most effective behavior change programs involve a combination of intervention types.” (Stern 2000).

What this means is that there is not a situation that can be fixed with one methodology. When trying to change behavior to be pro-environmental, it is very important to consider the audience and use a wide range of methods to reach as many people as possible. Often with individuals it is very difficult to have a universal fix that works for all. It also needs to be understood that even the best laid plans will not reach 100 percent of the people that are involved because individuals have individual barriers to behavior change.
Barriers to Change

It is important to not only think about the type of behaviors and how to change behaviors to be pro-environmental, but also to understand that people have personal, social, and institutional barriers that may be preventing a behavior change. When discussing barriers the assumption needs to be made that the individual in question wants to change their behavior to a pro-environmental behavior. These are not barriers of value change but barriers that are preventing a person from changing behavior. Figure 5 taken from Kollmuss integrates pro-environmental behavior change and barriers that may prevent the person from acting pro-environmentally after they have shown concern for the environment.

Figure 6 – Barriers between environmental concern and action (Kollmuss & Agyeman, 2002 pg. 247)
If we are looking at barriers to change after environmental concern is shown Figure 6 taken from Kollmuss & Agyeman, (2002 pg. 247) is a simplified version of what can be a barrier for an individual. To move from concern to a behavior a person must overcome all three of the barriers (individuality, responsibility, practicality) not just one. This adds another level of complexity to behavior change within an individual, even if a person wants to act, a simple thing like money or time could prevent them from acting. The purpose of discussing this briefly is to show the complexity of behavior change and that it is not a simple as incentivizing, educating, or appealing to common morality as discussed before. There are complex social issues that can prevent behavior change.

When developing projects for students that are intended to change behavior to be more pro-environmental, the psychology needs to be taken into account. The type of behavior needs to be identified, combinations of strategies need to be used, and, lastly, the educator needs to take the barriers of students into account. Chapter three will look deeper at strategies chosen to lead to pro-environmental behavior change using project-based learning.

**Project-Based Learning**

In a traditional classroom, the teacher is the source of knowledge and gives the students this knowledge through lecture, note taking, memorization, and testing. This is what is referred to as a teacher centered classroom setup. On the other end of the spectrum there is student centered teaching. This is where the student develops his or her own ideas through projects, developed and guided by the teacher. There are some major
differences between the two methods; teacher centered has firm lesson plans, while student centered learning has students learning the same concepts through teamwork and differing methods of learning. Project-based learning falls far on the student centered side of the spectrum.

The biggest advantage to project-based learning is that it allows for deeper thinking from the students. This deeper thinking allows for a deeper understanding and not just a fact-memorization-test scenario. A very integral part to project-based learning is teamwork cooperation and discussion of the focus topic. Students also need to work together to create some artifact (project) that demonstrates their learning and share their knowledge with the entire group of students.

Michael Grant (2002) identifies two major theoretical foundations for project-based learning: constructivism and constructionism. Constructivism is defined as, “individuals construct knowledge through interactions with their environment, and each individual’s knowledge construction is different (Grant 2002 pg. 2).” This means that students are doing different things to build knowledge but they are building their knowledge off of what they already know. This is a way to allow the students to scaffold themselves, because they are all starting with a different foundational knowledge. Constructionism is defined as, “individuals learn[ing] best when they are constructing an artifact that can be shared with others and reflected upon (Grant 2002).” Creating a project is allowing the student to take their knowledge one step further and make it meaningful to them. Using these two foundations Michael Grant developed a guide to the common features of a project-based lesson.
“(a) an introduction to ‘set the stage’ or anchor the activity;
(b) a task, guiding question or driving question;
(c) a process or investigation that results in the creation of one or more shareable artifacts;
(d) resources, such as subject-matter experts, textbooks and hypertext links;
(e) scaffolding, such as teacher conferences to help learners assess their progress, computer-based questioning and project templates;
(f) collaborations, including teams, peer reviews and external content specialists; and
(g) opportunities for reflection and transfer, such as classroom debriefing sessions, journal entries and extension activities.” (Grant 2002)

This is simply a framework for a basic project-based lesson, but even with a framework there are still some barriers to implementing a project-based lesson.

**Barriers to Project-Based Learning**

As mentioned before there is a spectrum from teacher centered learning to student centered learning and, as with most extremes, the majority of people fall somewhere in the middle and teachers follow-suit in the structure of their classrooms. Full student inquiry is a difficult thing to achieve with a lesson, but having a project-based classroom is incredibly difficult. Research shows that project-based/full inquiry/student led learning is the best method of learning; it teaches critical thinking, group work skills, and deep
and long lasting knowledge built off of students prior knowledge. Why don’t all teachers teach this way? There are a few major barriers to project-based learning.

Curriculum requirements and the time it takes to create a project is often a barrier that teachers first hit. Teachers are required to provide opportunity for all students to learn the state standards for their grade level and subject area. These are often numerous, and teachers often cannot get through the standards without adding project-based learning into their curriculum. With the pressure of state standards and the time intense planning that is required for project-based lessons, availability often does not allow for teachers to explore this method of teaching as an option.

The role of a teacher changes in the classroom, and this can create a feeling of discomfort and can prevent teachers from implementing project-based learning. Not to mention, the role of the student changes as well. The teacher becomes more of a guide for students than a fountain of knowledge from which they have to memorize information. This means that students also need to take on the role of cooperative group learners. Teachers are then required to teach these cooperative group skills to the students, which is also taking away from time that could be spent on curriculum and state standards.

Lack of materials and uncooperative students can also be barriers to project-based learning. Teachers could have a limited supply of research materials, computer time or additional materials to create the artifact that represents the knowledge obtained. Personally, I attempt two to three full inquiry experiments in my classroom every year and with students all completing different experiments, this requires me to purchase
materials immediately before the project because I do not know what the students are going to experiment on until the students decide. Having students completing eight different experiments in six different classes is both an energy and money drain for my part. All students are capable of learning in this way, but some student groups are more challenging than others. If the students do not allow for the teacher to try something new, the teacher can quickly lose motivation for project-based learning.

**How to Assess Project-Based Learning**

There are two major ways to assess project-based learning; students can create a portfolio or the teacher can create a rubric (Grant 2002). A student created portfolio has the advantage of showing student growth overtime, but has the distinct disadvantage that it is difficult to grade and often becomes subjective. A rubric is a method that is objective and is given to the students before the project begins to help guide them on how to get the score they want. The disadvantage of a rubric is that the students are guided much heavier in the direction that the teacher wants them to go, so this can limit or hinder some learners. Rubrics are also a grade that is given at a single point in time as opposed to comprehensively and can be difficult to show student growth. Either one of these methods of assessment is shown to be effective (Grant 2002), but which is used is a preference of the teacher.

A well-planned project can allow students to gain knowledge while building off of their own knowledge, construct an artifact that demonstrates learning, and work cooperatively with peers to learn, but many barriers prevent this type of learning from
being mainstream. When implemented, with time and care and assessed fairly by the teacher, project-based learning is a method of teaching students to critically think - a skill that many people are lacking and is an ultimate goal to elicit in students for many teachers.
CHAPTER THREE
RESEARCH METHODS

Introduction

The purpose of this theoretical implementation of project-based learning is to provide a mechanism for classroom teachers to analyze behavior change in students after implementation of a project. This will provide a framework for educators to synthesize and share information about student behavior change using project-based learning as a mechanism.

Why would creating a project aimed at behavior change be beneficial to the community as a whole? Research has shown that education is a mechanism for change in behavior, and if implemented with purpose, can change behavior as discussed in chapter two. If no attempt is made to change behavior, then behavior will not ever change. Educators do have a very strong influence on students whom they teach. In my opinion, it is a teacher’s responsibility to educate students not only on content and life skills, but also on responsibilities toward the environment. If educators give students the opportunity to change behavior and allow them to explore alternative options to habitual behavior the next generation of community leaders, or national leaders, will understand that there are options beyond what was done in the past to preserve the environment. This will move the next generation forward in thinking rather than stagnating or moving backward.

Food waste is a topic that affects all people, adults and adolescents alike. The focus of this project is on adolescents and behavior change within the age group of
12 to 14 years old. Food waste is an environmental behavior that they can actually change within their means. Choosing a topic that is actionable is important for this age group. Many environmental topics are beyond actionable for students, for example, global warming. This is not to say that students cannot take action to change their carbon footprint, but it is not a visible or real change that the students can tangibly see. Food waste is also a topic that can be applied in multiple locations. Students could work to lower food waste at school, in their homes, or even in their community. This is a versatile and palpable topic for students within this age group.

Chapter four will detail and provide information on two major elements of implementation, processes and tools. Continuing in chapter three I will discuss the purpose and reasoning behind the processes and tools used to implement this in the future.

Psychology of Food Waste Behavior Change in Students (process)

Private sphere environmentalism is the main goal of this project. Students will be creating a project to reduce food waste within their own homes, or school. This project will also be open-ended enough to allow students to move into the non-activist behaviors in the public sphere. This is possible because the students are allowed to conduct their own research and choose a path that best fits within the behavioral barriers the students have. To gather information on what possible barriers the students may have a survey sheet will be given to them pre-project. The teacher will use this information to group the students, which will challenge
them to change behavior, but not push so far to overstep the barriers that the student has developed. A 1-10 scale will be used to identify where the students lie on the three major barriers identified by Blake (1999) individuality, responsibility and practicality. This will be detailed further in chapter four.

As discussed in chapter two, more knowledge on a topic is not enough to cause a behavior change in a person, especially if they have personal barriers. This project will focus on students acquiring knowledge to further their understanding and also a level of community management that is actionable. There is also a potential for cultural and religious research, this is not the focus of the project, but if a group is interested in this direction of research, it will be allowed. To make sure that students are using multiple approaches a rubric will be used and designed to encourage knowledge acquisition, and community action. This will be an action research project, so knowledge is gained and used to make a meaningful change for the students.

**Barriers (process)**

While implementing and designing projects to be used to change behavior, barriers to change need to be taken into account. Blake (1999) discussed three major barriers to behavior change within a person; individuality, responsibility, and practicality. An attempt will be made in the project to provide an opportunity to overcome these barriers and allow student behavior to change from environmental concern to pro-environmental behavior.
The individually barrier is a lack of interest or laziness. The first thing that needs to be done to overcome this barrier is to make the project interesting and engaging from the start of the project. In an attempt to do this the project will start with an activity that will involve eating and discarding garbage, then allowing them to weigh how much was thrown away. Keeping the engagement and interest high throughout the project is placed on the shoulders of the student group. The pilot lesson is where the teacher will directly affect the interest level of the students.

Responsibility is a very intrinsic barrier for the students to overcome. The teacher needs to create a feeling of need for the behavior change. Within the project this will be addressed within the rubric, but it is still the responsibility of the teacher to explain or emphasize why students should feel a level of responsibility to decrease their food waste.

The final barrier is practicality; this is how practical or realistic it is that the person can sustain this behavior. These are barriers such as money, time, and resources. The goal of the student inquiry is for them to design a plan to decrease their own food waste. Part of the rubric will be focusing on the ease of the action plan. The easier the plan the higher the grade will be. This will customize the fit the practicality of the individual or small group.

Even with the built in availability for overcoming barriers there will still be resistance to pro-environmental behavior change. The goal of this project is to see if it will generate a behavior change in the majority of the class it is implemented in. To get the best result it needs to be interesting and engaging from beginning to end.
to overcome the individuality barrier. It must also help the students understand the need for behavior change and provide a doable solution so the responsibility and practicality barriers can be overcome.

**Strategies for Implementation (tool)**

To implement this project students will need to be pre-taught skills and concepts to help them be successful. This project is designed for 11-14 year old students. Some skills will need to be assumed taught during elementary years. These skills include at least a 4th grade reading level, and basic math skills including averaging and graphing data that is collected. Scaffolding will need to be provided for students who are not at the 4th grade reading level to allow for success. Some options for scaffolding include purposeful grouping of students and allowing for partner reading, lower level reading assignments, or orally reading to the lower level students if time allows. Stronger scaffolding strategies can and should be used in extreme cases of low reading levels. If students do not have the math skills mentioned before, groups can be divided into roles where one student is the mathematician and teaches the other students how to complete the math portion of the project work.

Common features of this project will be detailed further in chapter four, but major types of formative and summative assessments follow. Students will have to take a pre and post behavior survey to evaluate if behavior change happened. The majority of this project will be assessed through a rubric that follows the
International Baccalaureate grading scale. This is a 1-8 scale that measures students based on their current level and allows for growth in the future. Students will also be expected to complete the same rubric as a self-assessment and will have to grade at least one other group using the rubric as a peer assessment. Having the student’s use this rubric multiple times is done on purpose to allow them to gain a strong understanding of how they are graded. The students will also be provided a project guide sheet that will explain how to complete the project. All assessments will use none judgmental language so the rubric and guide do not inadvertently affect that students food waste behaviors. This is important so wording within the assessment tools does not compromise the project.

Project Outline and Timeline (tool)

The timeline is approximately 13 classroom hours with an additional five to six homework hours, if a classroom teacher it will take three to four classroom weeks with one week worth of curriculum interwoven. A detailed outline follows.

- **Introduction Lesson (1 hour/day)**
  - What is food waste (how to define food waste)
    - Direct instruction intertwined with small group discussions
  - Human connection with food
    - Small group to large group discussion
  - Explanation of project
- Rubric will be explained
- Pre-assessment behavior survey
  - Attached Materials (sheets)
- Power point
  - Used to guide direct instruction of the introduction lesson.
- Rubric for project-IB based
  - Provided to students before project so students know how they will be getting assessed.
- Pre-assessment behavior survey
  - Used to identify barriers and group students meaningfully.

- Developing project idea \(\rightarrow\) (1 hour/day)
  - Students are given their work groups based on previous days assessment.
  - Students will be given discussion topics to come up with ideas on how to implement project.
    - Students given guide sheet to help understanding of project.
    - Project can vary on implementation
  - Attached materials
- Project Guide sheet
  - Used to guide group discussions and project ideas.

- Power point
  - Display discussion topics and guide students further

- **Research Lesson** [3-4 hours/days]
  - Structured research
    - Teacher explains expectations and allows students time to develop ideas for project and research questions they have developed.
  - Attached materials
    - Research guide (student sheet)
      - Includes expectations and guidelines of research, keeps students focused on research the long research time.
    - Power Point
      - Displays places for research and expectations.

- **Implementing Project Lesson** [2 weeks]
  - Work time for students 4-5 class hours/day
    - Teacher guided, student work time.
- Project Presentation Lesson → (1 hour/day)
  - Trifold board walk about presentation
    - Students will self-assess and peer-assess their own project and another groups project respectively.

- Discussion/Debrief/Assess Lesson (1 hour/day)
  - Small group discussion
- Students discuss with their groups about differences and similarities within projects.
  - Jigsaw small group discussion
    - One student from each group combines with another group and discusses the same similarities and differences within the project.
  - Large group Debrief
    - Teacher will guide a discussion on the conversations the students had previously.
  - Attached materials
    - Behavior post-assessment Survey
      - Given at the end of the lesson to see if behavior has changed throughout project.

- Post Project Follow Up Survey
  - Long term survey given at least 1 month after project, same as pre-assess survey.
    - This is given to see if a behavior change has happened and if it is a long-term change.
CHAPTER 4
RESULTS

Introduction

This chapter will be broken down into two major sections; processes and tools. This is everything that will be needed to implement the project in the future. The processes are assessments on student knowledge growth and assessments on student behavior growth. These will be in the form of surveys before and after the project and a rubric to assess the student’s knowledge acquisition. The tools sections of this chapter will be tools needed to implement the actual lessons, which vary from lesson plans, worksheets, and a power point slideshow for the teacher.

Processes

Teacher neutrality

This is the most important process that must be taught with fidelity for this to be a valid test to see if this unit actually changes student behavior. The teacher must remain neutral in opinions. Teacher led discussions must be facilitated by asking questions of the students. These questions cannot be pressing them to change their opinions on food waste. If this project is not taught in this manner the opinions of the teacher may sway the student behavior change data one way or the other.

Pre-post behavior assessment survey (attached –appendix)

This survey will be based on the three major areas needed for behavior change
identified by Blake (1999) individuality, responsibility and practicality. This survey will be administered three times throughout the unit. The first time will be at the beginning of the unit to establish a baseline data point for student behavior. The second time will be at the end of the unit to see if the student behavior changed throughout the learning process, and finally it will be administered one month later to see if the behavior change was a long or short term behavior change.

Knowledge acquisition rubric (attached –appendix)

This will be a rubric that will assess student’s knowledge acquisition throughout the project. The rubric will be used by the students as a self-assessment tool, and a peer assessment tool at the end of the project. The teacher will also use this rubric to assess student summative knowledge.

Tools

Student guide sheets (attached –appendix)

These sheets are designed to guide the students along the project so the teacher does not have to re-explain directions to individual groups. It is important that the students feel a sense of ownership or they develop this for their project. If the students need help or get stuck throughout the project the teacher can use the guide sheets and point where the students should be nonverbally. It will be noted on sheets where classroom-based adaptations can be made.

Power point (attached –appendix)
This is a secondary means of guiding the students through the project while using nonverbal queues. The slideshow will primarily be used to guide the student learning, facilitate discussions and provide some background knowledge for the students.

**Unit plan (attached –Below)**

The unit plan is a guide for the teacher to follow for implementation of the project. Some adaptations can be made to fit student needs, but the project should be implemented with as much fidelity as possible. If an adaptation is made the teacher must note where and why they made this adaptation.

**Food Waste Project Unit Plan**

**MN State Standard**

(7.4.2.1.2) Life Science. Interdependence Among Living Systems. Natural systems include a variety of organisms that interact with one another in several ways. Compare and contrast the roles of organisms within the following relationships: predator/prey, parasite/host, and producer/consumer/decomposer.

**Objectives**

- Student will be able to define food waste.
- Student will be able to identify human’s connection with food.
- Students will be able to apply understanding of food waste through action research.
- Students will be able to effectively communicate ideas to others.
• Students will be able to cooperatively work as a team.

**New Vocabulary**

Food Waste - Definition designed by class discussion

**Materials**

• Projector/Computer/Power point
• Pre/post-assessment behavior survey
• Project Rubric
• Discussion guide sheet
• Project guide sheet
• Research guide sheet
• Science Notebooks (for students)
• Timer (large enough for students to see)
• iPad
• Laptop
• Document camera
• Tri-fold boards
• Construction paper (multi-colored)
• Markers
• Colored pencils
• Rulers
• Scissors

**Accommodations for different learners**

• Kinesthetic learning ➔ Tri-fold board creation
• Aural learning ➔ Discussions
• Large group learning (aural/verbal participation) ➔ Large group discussion
• Small group learning (aural/verbal participation) ➔ Small group discussion
• Visual/spatial intelligence ➔ warm up, notes, displaying directions on the board during work time.
• Verbal/linguistic learning ➔ Warm up, and direct instruction by teacher
• Logical learning ➔ Research for project
• Interpersonal learning ➔ Small and Large group discussion

**Day 1- Introduction Lesson (55 min)**

(5-7min) Warm up-“What is your favorite food and why?”

(20-25 min) Discussion- Class defines food waste, small/large group discussion on human connection with food.

(10 min) Pre-assessment behavior survey will be given.

(10-15 min) Rubric directions and expectations explained to students.

**Warm up (5-7 min)**
Students will begin class in their table groups. Groups will be sized 3-4 students, 3 students is preferable to 4. They will copy the warm up question and write down the answer in their science notebooks. The students are allowed to discuss with tablemates to build a team environment. The teacher will reveal the warm up on the projector which will read, “What is your favorite food and why?” and begin a timer for 5 min. As the students finish the warm up they will raise their hand and the teacher will come to them and check for completion. If the answer is completed the students receive a stamp (or a check mark). Once the 5 minutes have expired the teacher will get the student’s attention by counting down from 5 or another technique. The teacher will call on 4-5 students by taking volunteers who raise their hand.

“We will now talk about your warm up. Who would like to share their favorite food, and explain why it is their favorite?”

“Pizza, because it tastes good.”

“Tacos, because my family makes the best tacos.”

“Today we will be talking about food, but not the food you eat. We are going to talk about the food you throw away.”

Teacher reads the “objective” statements. Which are also projected on the power point slide. The teacher will then change to the next power point slide.

Discussion Part 1- What is food waste? (10-12 min)

The power point slide will project a question posed to the students.

“What is food waste?”
The students will be given 5 minutes to discuss what food waste is, how it is made and why we might waste food.

Note: There will be discussions throughout this project. It is expected that the teacher has already established how to discuss appropriately to the students. If the students have not established group norms take 5 to 7 minutes to discuss the expectations with the students. It is recommended that the student groups are randomly called on and a different “spokesperson” is assigned daily, this will allow more student voices to be heard throughout discussions.

The teacher will rotate through the room listening to the conversations, this is a great opportunity to simply listen and informally formatively assess the students’ knowledge of food waste.

After the 5 minutes is up, the teacher will gather the students’ attention and ask that each group share using their “spokesperson.” The teacher will call on each group randomly to share their thoughts. As each group shares the teacher will type student ideas onto the power point slide. Once every group has shared their discussion, the teacher will write a group definition of food waste using pieces from each discussion. If two or three groups share similar things make sure to address that it was said many times so it must be important to the definition. An example class definition follows.

“Food you throw away” ~**student 1**

“Food that you can’t eat, so we throw it away” ~**student 2**

“People waste food because we have so much if we did not have so much we might not throw it away” ~**student 3**
“Food that is thrown away, because we can’t eat it, or because we have too much food” ~class definition from teacher

The students will then copy the class definition into their notebooks. As the students are writing, the teacher will explain that this definition will and should change as the project progresses. After the students have completed copying the definition into their notebook, the teacher will change to the next power point slide.

Discussion Part 2- How are Humans Connected to Food? (10-12 min)

The power point slide will project a question posed to the students.

“How are humans connected to food?”

The same discussion procedures will be used as in discussion part one. After 5 minutes when the students are ready to share the teacher will have the students chose a different “spokesperson” from discussion one and then gather the whole group’s attention. As each group shares its ideas with the class the teacher will type the ideas into the power point slide. Once all ideas are on the board the teacher will wrap up the discussion. It is very important that the teacher does not place any judgment on the students ideas at this point, because if the students feel judged in the introduction they will shut down for the rest of the project and the chance for behavior change is lost. The teacher should simply say,

“These are all connections that humans have to food, and with this project we will be discovering more about food waste and further our understanding of our
connection with food. Before we look at this project we should find out what food we waste now.

Pre-assessment behavior survey (10 min)

The teacher will then hand out the pre-assessment survey. The students will be asked to complete the survey. After the 10 minutes have passed the teacher will collect the completed surveys and store for later. The students do need to write their names on this survey so the data can be tracked with that individual student. The names will not be used in the final analysis of the data. If more anonymity is needed students can write student identification numbers or initials.

Rubric Directions and Expectations (10-15min)

The teacher will hand out the project rubric to each student. Once every student has a copy the teacher will display the rubric via document camera (or any other method) and explain to the students how they will meet each criterion throughout the project. Be sure to leave 3-5 minutes at the end of class for questions on the project.

Assessment

Pre-Assessment-The discussion on what food waste is, assessing prior knowledge formatively.

Informal Formative-The students will be checked for understanding by the large group discussion.
Formal Formative-Pre-assessment behavior survey.

Summative-None

Post-Lesson

Teacher needs to use pre-assessment surveys to create student groups. The students will answer the 5 questions on the survey. When assessing which students will be placed in each group be sure that the students are no more then one answer away on the multiple choice. If students answered “a” another answered “b” they can be grouped together, but if the other student answered “c” or “d” they should not be placed together. On the scale questions be sure that the students that are paired together are both on the same side of the scale, left side or right side. Exceptions can be made in cases where the teacher strongly feels that the students will be more successful with their group. The survey sheet should have a strong correlation with group choice, so students of similar backgrounds and feelings on food are placed together.

Day 2- Developing Project Ideas Lesson (50 min)

(5-7min) Warm up-“How did we define food waste?”

(30-35 min) Student project discussion and groups assigned.

(10 min) Large group project idea discussion.

Warm up (5-7 min)
Students will begin class in their table groups. Groups will be sized 3-4 students, 3 students is preferable to 4. They will copy the warm up question and write down the answer in their science notebooks. The students are allowed to ask/discuss with tablemates to help find the answer. The teacher will reveal the warm up on the projector, which will read, “How did we define food waste?” and begin a timer for 5 min. As the students finish the warm up they will raise their hand and the teacher will come to them and check if the answer is correct. If the answer is correct the students receive a stamp (or a check mark). Once the 5 minutes have expired the teacher will get the student’s attention by counting down from 5 or another technique. The teacher will call on 4-5 students by taking volunteers who raise their hand. The teacher will then read the “objective” statements. Which are also projected on the power point slide. The teacher will then change to the next power point slide.

**Student project discussion and groups assigned? (30-35 min)**

The students groups, established last lesson, will be projected onto the board and the teacher will ask them to get move into their new assigned groups. Once in their groups the students will be given the project guide sheet. The groups will work together to complete this sheet. Each group will be expected to have 3 ideas for their food waste project. If a group finishes early have them discuss which idea is best and explain their reasoning to the group. Also run the same visual timer used in the warm up for 30 minutes this is the allowed work time. As the students are working and discussing their project, the teacher is expected to informally formatively assess the students, and to ask
guiding questions. When the timer runs out redirect the students to the board and change to the next power point slide.

**Large group project idea discussion (10 min)**

The board will display the title of “project ideas.” The teacher will randomly call on one student from each group asking for their group’s two favorite project ideas. As the ideas are shared the teacher will type/write them onto the board. The teacher will then ask probing questions to assess if the students have thought out their ideas.

“Which idea do you think is the most interesting, why?”

“How can you make sure your project is different than others?”

“How could you improve one of the ideas on the board?”

“What makes an idea for a project strong?”

**Assessment**

*Pre-Assessment*

The warm up at the beginning of class is intended to see if the students have retained the information from the previous class.

*Informal Formative*

As the students are working in groups the teacher will be walking around the room and checking in with students, and asking guiding questions for groups that are struggling.

*Formal Formative –*
The teacher will collect the group idea sheet and use this as a way to assess where the student groups are and adjust the next lesson if needed. The sheet will be returned to the student groups the next lesson.

*Summative*-None

**Post-Lesson**

Prep needed research materials based on student ideas. Gather books or print articles from online to provide the students with physical research methods. Laptops or iPads will also need to be prepared for the next lesson for the students to do research.

**Day 3-6 Research Lesson (4 hours)**

(5-7min) Warm up-“What interests you about food waste?”

(4 hours) Structured Research time

**Warm up (5-7 min)**

Students will begin class in their project groups. Groups will be sized 3-4 students, 3 students is preferable to 4. They will copy the warm up question and write down the answer in their science notebooks. The students are allowed to ask/discuss with tablemates to help develop their answer. The teacher will reveal the warm up on the projector, which will read, “What interests you about food waste?” and begin a timer for 5 min. As the students finish the warm up they will raise their hand and the teacher will come to them and check for completion. If the answer is completed the students receive
a stamp (or a check mark). Once the 5 minutes have expired the teacher will get the student’s attention by counting down from 5 or another technique. The teacher will call on 4-5 students by taking volunteers who raise their hand. The teacher will then read the “objective” statements. Which are also projected on the power point slide. The teacher will then change to the next power point slide.

Structured research time (4 hours)

The power point slide will display the expectations and goals for the day. The teacher will go through the expectations and direction verbally with the students, and check for understanding. Once the students are ready to proceed with research the teacher will hand out the research guide sheet. This sheet is designed to help the students find the information they need and provide them with good starting points to begin research or jump off points if they feel static in their research. The students will be able to use any research materials that the teacher has available from the school library, magazines, or textbooks. If none of these are available the research guide sheet provides websites that are suitable student resources to learn about food waste. Research is not limited to only these websites.

Note: in a traditional school schedule this lesson is a four-day lesson and is designed give students four full hours of research time.

The teacher’s job during this research is to provide support and guidance for the student groups, and formatively assess their knowledge throughout. It is also important that the
teacher is familiar with the technology provided to the students incase a technical issue arises.

**Assessment**

**Pre-Assessment**-

The warm up at the beginning of class is intended to see if the students have retained the information from the previous class.

**Informal Formative**-

As the students are working in groups the teacher will be walking around the room and checking in with students, and asking guiding questions for groups that are struggling.

**Formal Formative** –

The teacher will collect the research guide sheet and use this as a way to assess where the student groups are and adjust the next lesson if needed. The sheet will be returned to the student groups the next lesson.

**Summative**-None

**Post-Lesson**

As the students work through their research the teacher needs to keep track of materials the student groups may need or want to complete their projects in the next lesson.

Materials need to be gathered before the start of the next lesson.

**Interdisciplinary**
If you choose to consolidate time through collaboration, the teacher may choose to allow research time to happen in an English language arts class. If this route is chosen make sure that the collaborating teacher understands that no judgment statements can be made about food waste, because this could impact the behavior change data in the post unit survey.

**Day 7-17- Implementing project Lesson (2 weeks)**

(5-7min) Warm up-“What was the most interesting piece of research you found?”

(4-5 class hours _5-6 homework hours) Student project construction.

**Warm up (5-7 min)**

Students will begin class in their project groups. Groups will be sized 3-4 students, 3 students is preferable to 4. They will copy the warm up question and write down the answer in their science notebooks. The students are allowed to ask/discuss with tablemates to help determine their answer. The teacher will reveal the warm up on the projector, which will read, “What was the most interesting piece of research you found?” and begin a timer for 5 min. As the students finish the warm up they will raise their hand and the teacher will come to them and check if the answer is completed. If the answer is completed the students receive a stamp (or a check mark). Once the 5 minutes have expired the teacher will get the student’s attention by counting down from 5 or another technique. The teacher will call on 4-5 students by taking volunteers who raise their
hand. The teacher will then read the “objective” statements. Which are also projected on the power point slide. The teacher will then change to the next power point slide.

**Student project construction (4-5 class hours 5-6 homework hours)**

This lesson is split between work in the classroom and work outside of the classroom.

*In class work (day 1 must be in class)*

The teacher will display the project rubric on the board; this is review from lesson one. Going through the rubric with the student is important to remind them of the requirements needed on the trifold board. Change to the next power point slide, which will display a template for a trifold board. The teacher will go through how a tri-fold board works by questioning the students.

“What do you notice about how the trifold board works?”

“What parts are important, and why?”

“Where do you think most of your research will be placed?”

“How could you change this template to make it more interesting?”

This line of questioning is meant to engage the students in thinking about design the tri-fold board and what pieces are important. Provide the student groups with a tri-fold board and have craft materials available for the students to use (markers, rulers, colored pencils, scissors, construction paper, and any others that are applicable and available).

Allow the students to work for the remainder of the class time, providing support and informally formatively assessing student’s progress. During the 3-4 additional hours
display the expectations and requirements for the tri-fold board via power point, and provide the students with time to complete the project.

*Homework*

The students will be expected to complete the project as homework if not finished during class time. The project will not be assessed until one week after it is assigned as homework. During that homework week the teacher will have to intertwine curriculum not related to food waste into class time. This is done to allow students to digest the research that they have done and bring the information home, or at least out of school. It is important to the behavior change data that some of this project is done at home. To have a long term behavior change is important for the students to bridge the void between school and home so they can see the connection.

**Assessment**

*Pre-Assessment-

The warm up at the beginning of class is intended to see if the students have retained the information from the previous class.

*Informal Formative-

As the students are working in groups the teacher will be walking around the room and checking in with students, and asking guiding questions for groups that are struggling.

*Formal Formative – None

*Summative-*
Final project will be collected and graded via the rubric. The students will have an opportunity to self-assess their projects and to peer assess other student work.

Post-Lesson

Reorganization of the classroom may be needed to create a presentation area. Tri-fold boards will be used to display project. If classroom is not adequately sized the teacher may need to reserve the media center or library.

Day 18- Project Presentation (40 min)

(5-7 min) Warm up—“Why is it important for you to display your data to other groups?”

(10 min) Expectations of project presentation

(25 min) Project presentation

Warm up (5-7 min)

Students will begin class in their project groups. Groups will be sized 3-4 students, 3 students is preferable to 4. They will copy the warm up question and write down the answer in their science notebooks. The students are allowed to ask/discuss with tablemates to help find the answer. The teacher will reveal the warm up on the projector, which will read, “Why is it important for you to display your data to other groups?” and begin a timer for 5 min. As the students finish the warm up they will raise their hand and the teacher will come to them and check if the answer is correct. If the answer is correct the students receive a stamp (or a check mark). Once the 5 minutes have expired the
teacher will get the student’s attention by counting down from 5 or another technique.
The teacher will call on 4-5 students by taking volunteers who raise their hand. The
teacher will then read the “objective” statements. Which are also projected on the power
point slide. The teacher will then change to the next power point slide.

Expectations of project presentation (10 min)
The power point slide will display the expectations for the presentation and walk about.
The students will be allowed to wander the room and see the other student’s tri-fold
boards. While they are looking at others work the students are expected to self-assess
their project and peer-assess at least one other groups project. To do this assessment the
students will use the rubric from lesson one and provide a numeric quantitative
assessment and a comment explaining why they gave that numeric grade as a qualitative
assessment.

Project presentation (25 min)
Give the students this time to walk about the room and assess the student work. The
teacher should also be going around the room assessing student’s tri-fold boards using the
rubric during this time. This is to save grading time and to lead the students by example.

Assessment

Pre-Assessment-
The warm up at the beginning of class is intended to see if the students understand the importance of this lesson.

*Informal Formative-*
As the students are assessing student work, the teacher will be walking around the room and checking in with students, and asking guiding questions for individuals that are struggling.

*Formal Formative – None*

*Summative-*
Final project will be collected and graded via the rubric. The students will have an opportunity to self-assess their projects and peer-assess other student work.

*Post-Lesson*
Prepare materials for the final lesson, and reflect on questions or comments that may arise during final discussion lesson.

**Day 19- Discussion/Debrief/Assess lesson (50 min)**
(5-7min) Warm up-“What was something that all the projects had in common?”
(10 min) Small group Discussion
(10 min) Jigsaw small group discussion
(10 min) Large group discussion
(15 min) post behavior survey and teamwork self assessment
Warm up (5-7 min)

Students will begin class in their project groups. Groups will be sized 3-4 students, 3 students is preferable to 4. They will copy the warm up question and write down the answer in their science notebooks. The students are allowed to ask/discuss with tablemates to help find the answer. The teacher will reveal the warm up on the projector, which will read, “What was something that all the projects had in common?” and begin a timer for 5 min. As the students finish the warm up they will raise their hand and the teacher will come to them and check if the answer is correct. If the answer is correct the students receive a stamp (or a check mark). Once the 5 minutes have expired the teacher will get the student’s attention by counting down from 5 or another technique. The teacher will call on 4-5 students by taking volunteers who raise their hand. The teacher will then read the “objective” statements. Which are also projected on the power point slide. The teacher will then change to the next power point slide.

Small group discussion (10 min)

Students will discuss and fill out a discussion sheet individually the different food waste projects. This will be done by a T- chart on the discussion handout sheets. Students will be asked to complete part of the guide sheet and discuss projects for approximately ten minutes.

Jigsaw small group discussion (10 min)
The teacher will get class’s attention and ask students to count off by eights. These numbers will indicate the new jigsaw groups. The students will have to share what their group discussed in the small group discussion before.

**Large group discussion (10 min)**

The teacher will get the classes attention and ask the students to go back to assigned seats. Then the teacher will randomly call on students and ask them to share differences and similarities that were discussed in one of the two previous discussions. These will be typed/written on the board as students share the ideas. Address questions as they come up, but do not place any judgment on the student generated list.

**Post behavior survey and teamwork self assessment (15 min)**

The final piece of assessment data is to give the post assessment behavior survey and to allow the students to self reflect on their teamwork throughout the project. These two assessment pieces can be handed out separately or copied/stapled together. Give students time to complete. This is the final assessment of the project.

**Assessment**

*Pre-Assessment-

The warm up at the beginning of class is intended to engage the students in the discussion by asking them to write something individually first.

*Informal Formative-*
Throughout the discussions the teacher will have to assess where the students understanding is and adjust how to transition into the next discussion.

*Formal Formative –*

The teamwork self-assessment and the student discussion sheets will be collected and assessed by the teacher.

*Summative-None*

*Post-Lesson*

Analyze the behavior post-assessment survey by comparing to the pre-assessment survey and look to see if there was a behavior change.

**Post Project Follow Up Survey (1 month later)**

One month after the completion of the project the teacher will give the behavior survey one last time to see if there is a long-term change in student behavior.
CHAPTER FIVE

CONCLUSIONS AND DISCUSSION

Introduction

The importance of understanding food waste in the next generation is imperative and can solve many issues. These issues vary from world hunger and climate change, due to methane released in waste sites from food, to the activism of a local community. The content knowledge of food waste is important to teach, but also teaching students to discover information for themselves can be a very powerful tool for the future. After five years teaching in public schools, the biggest gap in skills that we teach is critical thinking. Many students can coast through school with passing grades and never really be challenged to think deeply. As much as this project has been about food waste, it is also about teaching the next generation to think critically about issues.

This project has caused me to learn things about myself, draw conclusions about teaching strategy, and reflect on what could be changed for future studies.

Conclusions

I have found that there is an inherent difficulty when interweaving psychology and teaching into a unit plan, while learning the importance of doing so. Since my undergraduate work, I have struggled to understand the importance of theory to practice. I would find myself asking the question *why learn the theory if it is not going to work in practice*. Through this project I found that a unit based in theory has a stronger purpose for the teacher and the students. Rarely in teaching do we look past the standards we are
teaching and this gets at the *what* we are teaching and then we develop a unit answering the *how*. Without considering the psychology behind the issue we are teaching, we do not get to the *why* of what we are teaching. My first conclusion is when an educator takes the psychology of an issue into the project they are teaching it makes it more meaningful to them, and in turn, makes it meaningful to the students. Getting at *why* we are teaching what we are teaching allows students and educators to critically think about the topic or issue.

Letting the student discover information and using project-based learning can also be concluded as a powerful tool used to teach critical thinking. Project-based learning can be used to, without deep diving into the psychology, teach critical thinking skills. Allowing the students to learn and discover on their own and discuss with peers has a longer lasting effect on the student’s ideologies. The teacher is not just filling empty vessels with new information, but also actually teaching them how to find and use the information. The second conclusion that can be made is when teaching a topic that may not have a psychological background, teaching students through projects can still elicit change in students and allow them to think critically about a topic.

Lastly, and not inherent to this project, students are given the opportunity to work within their community or homes. This teaches them that change can happen on a small, grass root, scale. Placing the power for change in student’s hands gives them meaning in what they are doing. This is not always part of project based learning, but can easily be incorporated to elicit change on a deeper level.
The food waste project that has been designed in this project effectively incorporates the first and second conclusion. The psychology why people behave the way they do surrounding food waste was used to shape the food waste project. Using project based learning to design this unit effectively meets conclusion two. Since this was a theoretical framework for the project the conclusions are drawn in theory not in practice. When this project is implemented it may, and probably will, need to be reworked to better elicit behavior change in students.

**Differences and Recommendations**

As mentioned before, there is a difficulty moving from theory to practice. This is a theoretical framework for teaching behavior change through project-based learning. Every time it is implemented changes and adaptations will have to be made to find the best method to elicit behavior change in the most students. Not only will there be changes to framework, but changes will need to be made to meet the needs of different groups of students. These changes are difficult to anticipate, but are expected.

The next steps with this project would be to implement in many different schools or programs and evaluate the effectiveness of certain aspects of the framework. The framework itself would be fluid, until it met the needs of the most students. I would recommend teaching this project with as much fidelity as possible, and then assessing which aspects need to be rewritten or reworked to meet the needs of the students being taught.
Personally, I would narrow the topic when implemented. I would not change the topic but narrow the scope for the student I teach. I might have them focus on food waste and landfill emissions, or food waste and household compost. Narrowing the topic, I feel, will help the students grasp the topic better. Then I would move into a larger more open-ended project surrounding food waste that the students would design. I would also like to look into different tools used to evaluate the ideologies of the students in place of the pre/post assessment survey developed for this project. Different tools may have different indicators and give a better idea of the behaviors of the students before and after the project.

Complexity of Food Waste

Food waste is a very complex issue, and is much more complex than I once had thought. I knew about the science behind food waste, because that is my background, but I had no idea the economics, the level of psychology, and barriers that are in place that create much of the food waste we have. Economically we have a system where it is cheaper to throw food away then to try and sell the imperfect foods. Grocery stores have policies that if the food is imperfect or near the sell by date that they throw the food away. They are not even allowed to donate the food to charities because there is not incentive and it costs more then just throwing it away. Packing and shipping imperfect foods is a cost not a benefit to a company. Much of the food is thrown away before it even reaches store shelves. This food could be used to feed the hungry, but instead we
put it in waste dumps where anaerobic conditions cause the decomposition of food to release methane, a stronger greenhouse gas than carbon dioxide.

The personal level of psychology that goes into changing food waste behaviors is immense. Kollmuss (2002) listed a large number of internal, personal, factors that prevent behavior change, but they also list many external factors that do not allow a person to change their behavior, even if they wanted to. If a personal wants to change their behavior and overcame all the internal barriers, and they have an economic situation that does not allow it, their behavior will not change. These factors do not only apply to food waste, but all pro-environmental behaviors. We have created a system where it is incredibly difficult to be pro-environmental, even if we want to.

**Incorporating Psychology and Project-Based Learning**

When planning units I try to always backwards design my lessons starting at the state standards. What I found out was by doing this, I am missing a key component, understanding the why I am teaching what I am teaching. Researching the psychological background really allowed me to understand why the topic was important to the students and myself. When backwards designing I realized that I was not going backwards far enough. There is so much more to writing a lesson, project, or unit then the state standards. Taking a step back into the theory behind my teaching really made the project meaningful to me, which in turn will make it more meaningful to the students.

As mentioned before, teaching critical thinking may be lost art to many teachers, but it is incredibly important to the future generations. Creating a lesson that is project
based, rather then fact or activity based allows the students to dive deeply into the material and allows them to think critically about a topic. Teachers are always on a time crunch to get through as much material as possible before the end of the year, but slowing down and allowing the students to think is very important in developing critical thinking skills.

Journey with Food is Just Getting Started

In chapter one, I discussed my personal journey with food. The most important thing that I learned about myself is that the journey is far from over. Food is such a fundamental element in my life, and something that I am passionate about. There is a vast amount of information about food, and I feel like I have only skimmed the surface with my science background. The politics that go into managing food are often overshadowed by other hot-button topics, but food is something that we all have in common. It is very important to know where your food comes from, and also where it goes if you don’t eat it. Before this, I was always focused on the former and not on the latter. I have learned that there are processes and barriers that will always exist. What is most important is not just accepting the world the way it is, but always striving and fighting to change it for the better.
APPENDIX A: ASSESSMENT TOOLS
Student Behavior Survey

1) When eating at home what type of food does your family normally eat?
   a. Boxed or canned food
   b. Mixture of boxed food and homemade food
   c. Homemade food

2) On a scale of 1-10 how much food gets thrown away at your house?
   Place a line on the scale where you think you are. (individuality)

   1…………………………..5…………………………………….10
   (no food) (some food) (a lot of food)

3) How often do you eat a meal as a family?
   a. 1-2 times a week
   b. 3-4 times a week
   c. 5-6 times a week
   d. Everyday

4) On a scale of 1-10 how do you feel about throwing away food?
   Place a line on the scale where you think you are. (Responsibility)

   1…………………………..5…………………………………….10
   (Do not care) (I care somewhat) (I care a lot)

5) On a scale of 1-10 how likely are you to do something about food waste in you
   home or community?
   Place a line on the scale where you think you are. (Practicality)

   1…………………………..5…………………………………….10
   (Not likely) (somewhat likely) (Very Likely)

6) What is your favorite home cooked meal? Explain why?

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

Note for instructor: 1-10 scale questions are adapted from Blake, 1999 and are used to
identify behavior change in students. Do not make any adaptations.
**Project Rubric IB format**

<table>
<thead>
<tr>
<th>Achievement level</th>
<th>Descriptor</th>
<th>Self assessment</th>
<th>Peer Assessment</th>
<th>Teacher Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Do not meet any descriptors below.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-2</td>
<td>Uses and applies some science ideas to food waste project. <strong>(Apply and use the concepts of food waste)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-4</td>
<td>Uses and applies most science ideas to the food waste project. Uses understanding to solve a complex problem. <strong>(Apply and use the concepts of food waste)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-6</td>
<td>Uses and applies science ideas to the food waste project. Uses understanding to solve a complex problem. Including something unfamiliar to you. <strong>(Apply and use the concepts of food waste)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**

(Use this space to defend WHY you are at this achievement level)
## Criterion D: Scientific Inquiry

<table>
<thead>
<tr>
<th>Achievement level</th>
<th>Descriptor</th>
<th>Self assessment</th>
<th>Peer Assessment</th>
<th>Teacher Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Do not meet any descriptors below.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-2</td>
<td>Attempts to state a focused problem, the method is incomplete, and an attempt is made to see if the method works.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-4</td>
<td>States a focused problem, but does not use science knowledge to explain. Method of design is mostly complete and partially checks to see if method works. Ideas for changes to method are made. Future areas to change are mentioned.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-6</td>
<td>Clear and focused problem. Correct materials are chosen. Method is tested and student explains if the method is valid and reliable. Realistic improvements to method are suggested and future areas of change are mentioned.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Notes:
(Use this space to defend WHY you are at this achievement level)

Note to teacher: This is specifically an IB (international baccalaureate) formatted rubric. If a different version of rubric is need for measuring student growth in your classroom you may adapt or re-work this rubric to fit your classroom. It is most important that the students are allowed to self and peer assess the project to reflect on their learn so that cannot change.
APPENDIX B: PROJECT IMPLEMENTATION MATERIALS
**Food Waste Project Guide Sheet**

Requirements

- Design an experiment or action research project around food waste
  - Experiment- has a scientific question, hypothesis, detailed procedure, data collection method, and a conclusion
  - Action research- Identify a problem with food waste, at home, in your community or at school. Design a project to solve that problem, and explain your finding
- Minimum of 5 resources
- Design a tri-fold display to present your project

Brainstorm (5-10 min)
Write down as many ideas you have (even if they are silly) below

<table>
<thead>
<tr>
<th>Idea</th>
<th>Why will it work</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Narrow your project ideas (5-10 min)

Directions: use the brainstorm ideas box above, and talk to your group about which ideas you think you will be able to actually do! List your top 3 and explain why you think this will work.

1. Idea
   Why will it work
   __________________________________________________
   __________________________________________________
2. Idea____________________________________
   Why will it work
   __________________________________________

3. Idea____________________________________
   Why will it work
   __________________________________________

Food Waste Project Idea
Directions: Choose 1 from the list of 3 above and answer the questions below about your final idea. Your entire group must agree on the idea chosen.

Which Idea did you choose 1, 2 or 3?
____

Is this idea action research or an experiment?
____________________

Why do you think this idea is interesting?
________________________________________

What do you need to learn before you can start your project? What research is needed?
________________________________________

Note to teacher: If you need to adapt the language in the questions or change the research requirements to meet the needs of your students that is fine. Please do not change the overall format of the idea generation though.
**Food Waste Research Guide Sheet**

Directions: You will be given 4 class periods to research your food waste project. You must have at least 5 resources for the project. The more resources and learning you do in these 4 classes the easier the rest of the project will be. The research materials will only be available to you for 4 class periods, if you need to learn more it will need to be done as homework during the project. This sheet is designed as a guide to help you find the information you need, not as a fill in the blank worksheet.

Information you find on your project will have to be placed in you science notebook, along with where you found it.

You should make a t-chart in your notebook, you can copy the one below.

<table>
<thead>
<tr>
<th>What I found</th>
<th>Where I found it</th>
</tr>
</thead>
</table>
Available resources.

- Textbooks
- Books from library
- Magazines
- Online resources
  - Good places to start
    - http://www.foodwastealliance.org/
    - http://www.worldfooddayusa.org/food_waste_the_facts
    - http://www.epa.gov/foodrecovery/
  - Any other websites that help you learn about your project.
    - Google is a search engine not a resource!
## Food Waste Discussion Sheet

**Discussion with your group**

<table>
<thead>
<tr>
<th>Things that you learned</th>
<th>Things you would change or do different</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Discussion with jigsaw group**

<table>
<thead>
<tr>
<th>Things I learned from other groups</th>
<th>Things we can still learn</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note to teacher:** This sheet can be modified heavily to meet student needs. It is just important that the students have an opportunity to reflect and discuss with another group.
Warm up - What is your favorite food and why?

- Student will be able to define food waste.
- Student will be able to identify human’s connection with food.
- Students will be able to effectively communicate ideas to others.

What is Food Waste?

- (Student Ideas)
How are humans connected to food?

• (student ideas)

Warm up- What is your favorite food and why?

• Student will be able to identify human’s connection with food.
• Students will be able to apply understanding of food waste through action research.
• Students will be able to effectively communicate ideas to others.
• Students will be able to cooperatively work as a team.
Developing Ideas Lesson

Warm up- How did we define food waste?

- Student will be able to identify human's connection with food.
- Students will be able to apply understanding of food waste through action research.
- Students will be able to effectively communicate ideas to others.
- Students will be able to cooperatively work as a team.
Project Ideas

- (student ideas)

Research Lesson
Warm up - What interests you about food waste?

- Student will be able to identify human's connection with food.
- Students will be able to apply understanding of food waste through action research.
- Students will be able to effectively communicate ideas to others.
- Students will be able to cooperatively work as a team.

Research Time

Expectations
- Everyone in group has a task
- Work cooperatively
- If you have a question as teammates first then call over teacher
- Be respectful of research materials and technology

Goals
- Day one
  - One resource found
- Day two
  - 3 resources found
  - At least 8 pieces of information found
- Day three
  - 4-5 resources found
  - At least 12-15 pieces of information found
- Day four
  - 5+ resources found.
  - 20 pieces of information found
Implementing Project Lesson

Warm up- What was the most interesting piece of research you found?

- Student will be able to identify human's connection with food.
- Students will be able to apply understanding of food waste through action research.
- Students will be able to effectively communicate ideas to others.
- Students will be able to cooperatively work as a team.
Project design

Expectations
- Everyone in group has a task
- Work cooperatively
- If you have a question as teammates first then call over teacher
- Be respectful of materials

SLIDE 15

Project Presentation Lesson

SLIDE 16
Warm up- Why is it important to display your data to other groups?

- Student will be able to identify human’s connection with food.
- Students will be able to apply understanding of food waste through action research.
- Students will be able to effectively communicate ideas to others.
- Students will be able to cooperatively work as a team.

Project Walk-about

- Expectations
  - Use respectful language when talking about others work
  - No running
  - Need to complete
    - Self-assessment (grade your project)
    - 1-2 peer assessments (grade another group)
Large group discussion

Similarities
• (student ideas)

Differences
• (student ideas)

Notes to teacher
• This power point presentation is designed to be an outline to be manipulated to fit the technology you have available in your classroom. If you need to modify this slideshow to work with a promethean board or smart board, this is acceptable. This slideshow follows the format of the unit plan in chapter 4, modifying the look of the slide show is acceptable, but do not modify the lessons or worksheets unless indicated.
REFERENCES


