INTRODUCTION
This project is a contribution to NARA’s (Northwestern Advanced Renewables Alliance) research on collecting discarded woody biomass (slash piles) and converting it into jet fuel. It is particularly focused on the energy literacy branch of the research which helps the effort in many ways including increasing citizen support for the production of biofuels. My research task was to develop curriculum to teach children about energy and NARA’s research. Up to this point, the work on energy literacy has been primarily focused on middle and high schoolers. There is little to no information on elementary aged students, which is the targeted age group for this project.

The content for the curriculum was inspired by the Energy Literacy Principles which outline the concepts an energy literate citizen should understand. Given the age group, the curriculum is not meant to teach in-depth information about energy but to provide a basis for better understanding when they get older.

METHODS
First, I decided which concepts I wanted to teach the students. I settled on what energy is, where it comes from, how we use it in our daily lives, and the difference between renewable and nonrenewable energy resources. Then, through four phases I developed a lesson plan.

Phase 1: Interviewing and observing day campers
• I asked students questions to see how much they knew about energy and how they might enjoy learning.
  o Questions: What is energy? Where does energy come from? How do we use energy? What was one of your favorite activities you have done in school?
• Observation: I taught the kids for a couple weeks before I started practicing my lesson with them. Although each week I had a different set of kids of different ages, I was able to get a feel for the setting and the overall level of engagement.

Phase 2: Initial lesson plan development
• I designed a board game thinking about a game that would represent the NARA process and also teach about the exchange of energy, what energy is, and about how renewable energy sources are better for the environment than nonrenewable sources.
  o The game is designed loosely based off of Monopoly where players go around a board to rack up units of energy and can lose energy by landing on certain spaces and there are wild cards which are like Monopoly Chance cards. The object of the game is to get enough energy to get through the various steps of the NARA process.
  o I added an Introduction and Debrief to the game instructions to solidify the learning experience and clearly discuss what energy is, the NARA process, and renewable and nonrenewable resources.
  o I practiced the game with another adult to make sure it works and changed some of the values and wording as needed.

Phase 3: Pilot testing board game and Reflection
• I facilitated the game for four students aged 6-9.
• Half of the students were engaged and half were not. There were two groups that played together.
  o The second group was primed by their teacher about the game and were anticipating playing.
  o In the Debrief, I decided I could add a section where I congratulate them on finishing the game and list off how they helped the environment by using bio jet fuel instead of petroleum based fuel.

Phase 4: Revision and Retesting board game and Final Reflection
• I brainstormed how I could make the game more engaging, or at least understandable for elementary aged students, which is the targeted age group for this project.

RESULTS/DISCUSSION
• Trial 1: I facilitated the game for four students aged 6-9. Half of the students were engaged and half were not. The half that were engaged did seem to understand the game and its learning objective and all of the players were able to catch on to how to play the game. Most of the students said they really liked the game.
• Trial 2: The students that participated in this trial were slightly older (8-10). There were seven students so they all played in teams. 2 players had played before. They all seemed very engaged in the game and seemed to like it. One of the players that played again remembered what was taught the last time he played.
  o The way I conducted the first trial was different from how I conducted the second. I think the difference in results was due to the attitude of the groups. The first group was focused on wanting to do their own crafts and wanting to go swimming while the second group had been primed by their teacher about the game and were anticipating playing.
  o I brainstormed how I could make the game more engaging, or at least the intro and debrief so that the students can part of the lesson on what energy is, how it is used and renewable vs nonrenewable energy resources.
  o Instead of reading the introduction part I could show a video or do a hands-on activity that presents the same information in a more engaging way.
  o In the Debrief, I decided I could add a section where I congratulate them on finishing the game and list off how they helped the environment by using bio jet fuel instead of petroleum based fuel.
  o I was thinking to make the game more challenging and interesting I could have the players answer a question in order to achieve the mini-goals. For example: What is an example of an energy source? This implies more learning about energy into the game since most of it was in the Introduction and Debrief. Having them answer the questions themselves will also help them retain the information better.

• Trial 3: This group consisted of eight 6-9 year-olds with most of them on the younger end of the spectrum. One player was 4 years old. They played in teams of 2 again. None of them were interested in learning or playing the game from the beginning and it went very slowly and they were all very uninterested and distracted. They did not finish game but I was able to get through the Debrief. I implemented the change in the Debrief and used a fellow intern’s video on energy in place of the Introduction.
  o In this trial, these changes did not seem to impact the quality of the learning experience in a negative or positive way. However, the conditions of the trial (the kids being so young and distracted from the beginning) makes it difficult to gauge the efficacy of these changes.

• Trial 4: In this game, six 6-10 year-olds played; three of whom had played before. I implemented a matching activity in place of the Introduction, the new change to the Debrief, and had players answer a question about energy to attain the mini-goals. These students were also disinterested from start because they wanted to go swimming. Despite this, the changes I implemented for this final trial did add a higher level of engagement and learning.

• There is room for improvement for the questions because the students seemed confused about the questions and needed clarifications. It might also help to increase clarity in the Introduction so they can have a better understanding of the terms used in the questions.

REFERENCES