Team Number: RRCA1
School Name: Rio Rancho Cyber Academy
Area of Science: Thermodynamics
Project Title: Ice Ice Power Baby

Problem:
Refrigerators are one of the leading causes of power consumption. Is there any way to make it more efficient or less power consuming? There might be. In this experiment it is being tested whether cooling the refrigerator more in the morning and evening time and then turning it off for the night time (about 8 hours) will still keep the food fresh and also conserve energy. The reason it will be turned off during the night time is because that is a time when people will not be using their fridge during these hours and this is when the sun is not shining.

Solution:
Through tests and simulations with NetLogo, the cooling values needed to keep the food from not freezing, but also will be cold enough to have it stay fresh through the night will be determined. When reducing power used at night (when the solar panels are not absorbing energy) this prevents the use of more energy than needed. This prevents the energy from being transferred from the grid. When energy is transferred to and from the grid, approximately 10% of the total energy is lost due to inefficient wiring of the grid. Not using more power than needed allows energy to be stored locally allowing for more efficient energy use and saves money. With these values tests can be run with "food" on the model and see if these values work and keep it from spoiling. Finally, it will be determined whether or not this will conserve energy and if so, how much it conserves.

Progress:
Up to this point, a model has been built that shows what value the thermostat cycling percentage will be at if it keeps switching on and off throughout the day. This is helpful because that is how most energy efficient fridges work and this will help to make a more real-world based simulation. In our model we use a blue box is in the center of the fridge, which cools the air particles if it touches it. Also, whenever the air touches the sides of the refrigerator walls then it warms the air slightly. If the air particles get to an average of 32 degrees (Fahrenheit) then the thermostat turns off and the blue patch does nothing. However, if the average temperature of the air particles gets up to 40 degrees (Fahrenheit) average, then the thermostat turns back on and the blue area gets its cooling property back. It was found that the cooling value is around 0.004 to 0.012 degrees. It was also found that whenever it touches the side, then 0.06 to 0.14 degrees should be added on to have a 50/50 on-off cycle.

Expected Results:
After the program is finished and the food is placed inside the fridge, then a ground-breaking discovery is expected. A way for houses all over the world to conserve energy by a significant

amount will have been found. This is because this experiment is expected to work towards its intended purpose. This purpose is to find a way for food to not spoil and to conserve energy. Also, if a fridge that is trying to save energy by turning on and off throughout the day is used then this can cause a significant decrease in the energy use of a fridge.

Resources:
- https://www.fda.gov/food/resourcesforyou/consumers/ucm253954.htm
- https://www.consumerreports.org/cro/news/2012/06/when-it-s-hot-help-your-refrigerator-keep-its-cool/index.htm
- https://www.fsis.usda.gov/wps/portal/fsis/topics/food-safety-education/get-answers/food-safety-fact-sheets/safe-food-handling/refrigeration-and-food-safety/ct_index
- http://www.idph.state.il.us/about/fdd/fdd_fs_foodservice.htm
- http://physics.csustan.edu/Ian/HowThingsWork/Topics/Temperature/ThermoLaws/Refrigerators.htm
- https://en.wikipedia.org/wiki/Heat_pump_and_refrigeration_cycle
- http://web.mit.edu/16.unified/www/FALL/thermodynamics/notes/node25.html
- http://web.mit.edu/16.unified/www/FALL/thermodynamics/notes/node25.html
- http://www.northdevon.gov.uk/business/food-hygiene-and-safety/food-safety-tips/temperature-control/
- http://www.logan.qld.gov.au/__data/assets/pdf_file/0003/4089/knowingyourfridge.pdf
- **ASHRAE Handbook 1977 Fundamentals (Thanks to Bob Robey who gave this resource to us)**

Team Members: Gabriel Turner, Dylan Martinez, and Chris Meyer

Sponsoring Teacher: Harry Henderson

Mentoring Teacher: Bob Robey