A Dirty World

Name: Joseph Puccio

Lab Partner: None

Science Lab Report • MCS Adolescents • May 30, 2022

Introduction:

In an increasingly populated world, cheap, and unhealthy ways of living have been more abundant. With the United States need of energy growing larger, mainly from an unfortunate dependancy on foreign oil, we have fallen into what might be considered as "the point of no return." In which we have altered the contents of our planets atmosphere to a point where it may not be healable. The possibility of this is surprisingly high, for example if you were to paint a basketball blue, the relationship between that basket ball and the layer of paint is equal to the relationship between the Earths atmosphere and the Earth. That shows the mere size of the Earths atmosphere, and the potential ease of destroying it.

Currently the three most common greenhouse gases are Carbon Dioxide, Water Vapor, and Methane. Greenhouse gases play a very important role in the greenhouse affect. When the suns light reaches our planet some of the radiation is reflected by the atmosphere, while the rest makes its way through our atmosphere to the Earths surface, which either reflected off of the surface or is absorbed by the Earth. The Earth then releases some of the light, in the form of infrared radiation, resulting with some of it being trapped heating the Earth, and the rest radiating back into space.

Now the trapping of some of the infrared radiation is essential to our survival, without this affect our Earth would be cold to the point where we could no longer inhabit it. However, an increase in the Greenhouse gases listed above could result in more of the infrared radiation being trapped thus warming our climate to a larger extent.

Purpose:

The purpose of this lab is to discover the differences each of these following three elements have on an environment, including any change in temperature, affects on the plant and creature life, and any affects on the environment as a whole:

- Carbon Dioxide
- Water Vapor
- Methane

Hypothesis:

I hypothesize that when inserting Carbon Dioxide the plant life will remain the same if not thrive, the heat may increase slightly, and animal life will not be affected dramatically. I hypothesize that when inserting Water Vapor into the closed environment, the temperature will remain the same if not decrease due to reflected sunlight off of the vapor, I hypothesize that the plants and animals will not be affected very much. I hypothesize that the Methane will decrease the plants growth if not kill them along with the animals, I hypothesize that the temperature will increase slightly.

Materials & Equipment:

- ❑ 10 Gallon Fish Tank
- ❑ Cover for Fish Tank
- ❑ Duck Tape
- ❑ 1 (1 Gallon Milk Tank)
- ❑ 2 Small Chunks of Dry Ice
- ❑ Small Portable Fan
- ❑ 1 Sheet of Tinfoil
- ❑ 1 Gallon of water
- ❑ 1 Bag of Soil
- ❑ 15 Small Plants
- ❑ 1 Bag of Sand
- ❑ 1 Bag of Clay
- ❑ Lamp
- ❑ Thermometer
- ❑ 1 Cloth

Procedure:

1. Set the 10 Gallon Fish tank on a solid surface
2. Firmly place the Fish Tank cover into the fish tank
3. Inspect the tank to make sure that the cover fits comfortably
4. Remove the fish tank cover, and place the clay evenly along the bottom of the tank
5. Pour all of the soil into the left side of the tank, and pat it down firmly
6. Pour all of the sand into the right side of the tank, and pat it down firmly so that the soil and sand are even in height
7. Mold the tinfoil over the sand in the form of a plate exposing the most surface area
8. Plant 5 plants randomly across the surface of the soil and the sand
9. Tape the thermometer in such as way it is measurable from the outside
10. Clamp the lamp onto the table and adjust it over the fish tank but do not turn it on
11. Turn on the lamp and record the initial temperature every minute for five minutes
12. Turn on the lamp, and pour half of the water into the tinfoil, close the top immediately and seal the cracks with duck tape
13. Record the temperature every minute for one hour, as well as any observations about the environment
14. After one hour remove the top from the tank and use the fan to circulate the air, clean the glass using a wet cloth, and replace the plants with new ones
15. After letting the tank sit for 15 minutes and being cleaned thoroughly, and return to the initial temperature, remove the water and the tinfoil and add the dry ice into the fish tank and seal it immediately

16. Record the temperature every minute for one hour, as well as any observations about the environment
17. After one hour remove the top from the tank and use the fan to circulate the air, clean the glass using a wet cloth, and replace the plants with new ones
18. After letting the tank sit for 15 minutes and cleaning it thoroughly, close the top
19. Record the temperature every minute for one hour, as well as any observations about the environment
20. After one hour remove the top from the tank, clean it out thoroughly and remove any abnormalities from the tank such as small pieces of dry ice.
21. Record the temperature every minute for one hour, as well as any observations about the environment.
22. Dispose of the rest of the materials

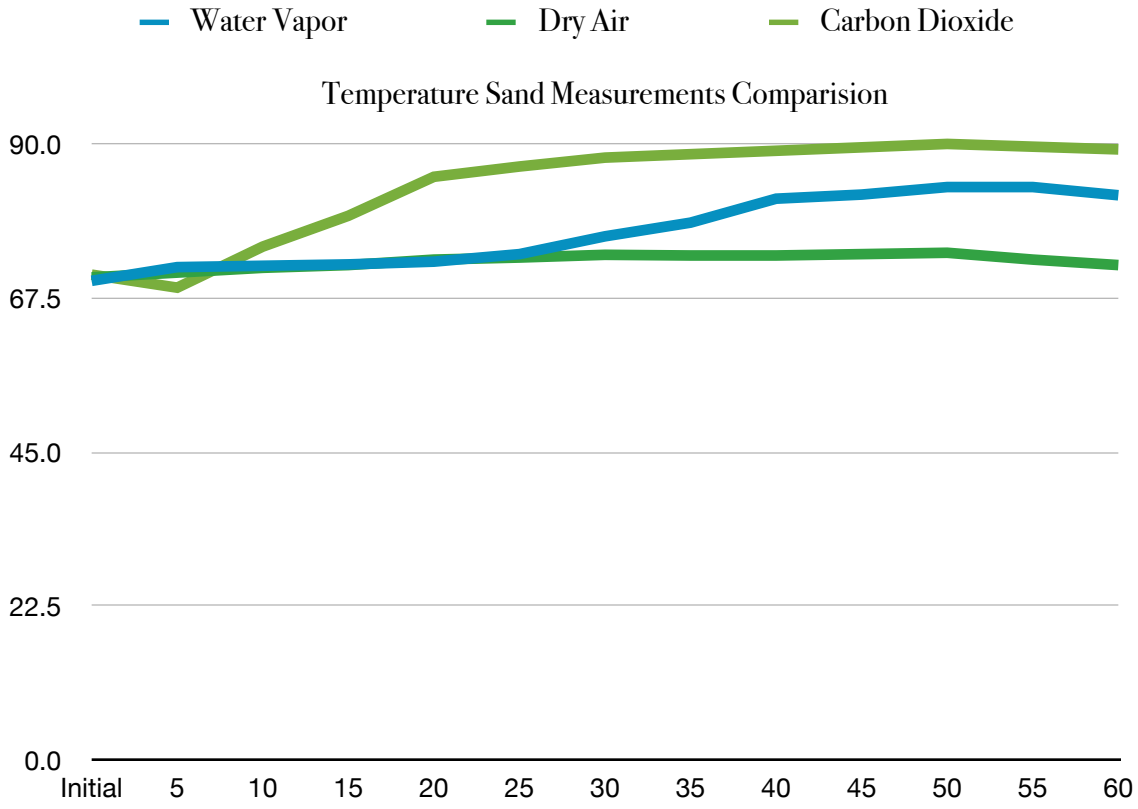
Data Tables & Observations:

Minute	1st Trail Soil	1st Trail Sand	2nd Trail Soil	2nd Trail Sand	3rd Trail Soil	3rd Trail Sand
1	72.5	71.5	71.5	72	71.5	69
2	73	71.5	71.5	71.7	75.1	69.5
3	73	71	71.5	71.5	75.6	69.7
4	73.5	71.5	71.7	71.9	78	69.9
5	74	72	71.9	71.9	80	69.9
6	74.5	72	72	71.9	80	70
7	75	72	72	71.9	80.2	73.1
8	75.2	72.2	72	71.9	80.1	74.5
9	76	72.1	72.4	72.2	80.1	75.4

Minute	1st Trail Soil	1st Trail Sand	2nd Trail Soil	2nd Trail Sand	3rd Trail Soil	3rd Trail Sand
10	76	72.2	72.4	72.2	79.9	75.5
11	76.4	72.3	72.5	72.2	79.9	76.5
12	77.2	72.4	72.7	72.3	79.9	77
13	77.6	72.6	72.3	72.2	79.8	77.5
14	78.1	72.5	72.9	72.3	80	78.5
15	78.5	72.5	73	72.3	81.2	79
16	78.9	72.6	73	72.4	82.1	80
17	78.9	72.6	73	72.4	81.9	82.1
18	79.5	72.8	73.1	72.9	81.8	83.2
19	79.7	72.8	73.2	73.2	81.7	84.1
20	79.8	72.8	73.1	73.1	81.7	85.2
21	80.1	72.8	73.3	73.3	81.6	85.2
22	81.2	72.8	73.4	73.4	81.6	86.1
23	81.2	72.7	73.5	73.4	82.1	86.1
24	81.3	73.1	73.4	73.4	82.1	86.3
25	81.4	73.9	74.1	74.1	82.1	86.7
26	82	74	73.4	73.4	82.1	87.6
27	82	75	73.4	73.4	82.9	87.7
28	81	75.2	73.4	73.4	81.9	87.8
29	81	75.1	73.3	73.3	81.7	87.9
30	82	76.1	73.4	73.4	81.6	87.8
31	82.3	76.5	73.7	73.7	81.5	87.9
32	82.3	77.2	73.7	73.7	81.4	88.7

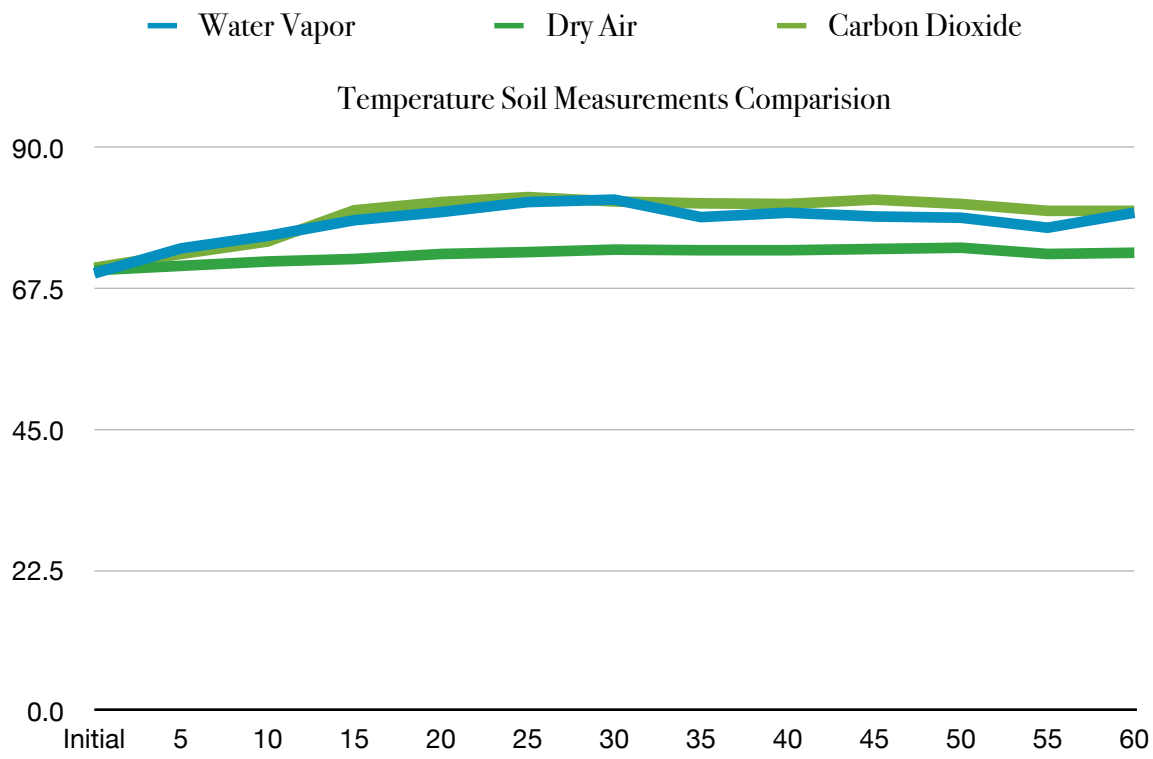
Minute	1st Trail Soil	1st Trail Sand	2nd Trail Soil	2nd Trail Sand	3rd Trail Soil	3rd Trail Sand
33	80	77.4	73.7	73.7	81.3	89.6
34	79.5	78.4	73.7	73.7	81.5	90.4
35	79	78.5	73.7	73.7	81.3	90.5
36	79.6	78.6	73.9	73.9	81.4	90.4
37	79.5	79	73.9	73.9	81.5	90.6
38	79.5	80	73.8	73.8	81.3	90.5
39	79.7	81.4	73.7	73.7	81.3	90.6
40	79.6	82	73.7	73.7	81.2	90.7
41	79.3	82	73.7	73.7	81.2	90.8
42	79	82.4	73.7	73.7	81.2	90.6
43	79.1	82.6	73.6	73.6	81.3	90.4
44	79.1	82.3	73.6	73.6	81.4	90.9
45	79.2	82.5	73.5	73.5	81.3	90.6
46	79.3	82.4	73.5	73.5	81.2	90.9
48	79.1	82.4	73.4	73.1	81.2	85.1
49	79.2	83.1	73.3	73.1	81.1	85.1
50	78.7	83.5	73.1	73.1	81	84.9
51	78.9	83.7	73.2	73.1	81	84.9
52	78.9	83.8	73.3	73.1	81	84.3
53	77.8	83.9	73.4	73.4	81.1	84.3
54	77.7	84	73.2	73.1	80.1	84.3
55	77.3	84.1	73.1	73.3	80.1	84.5
56	78.4	84.5	73	73.1	80	85.3

Minute	1st Trail Soil	1st Trail Sand	2nd Trail Soil	2nd Trail Sand	3rd Trail Soil	3rd Trail Sand
57	79.4	84.3	73.1	73.4	80	85.3
58	79.4	84.6	73.1	73.5	80	85.1
59	79.6	84.2	72.9	73.1	80.1	84.8
60	79.7	84.1	71.6	72.4	80.3	85.1



Observations & Notes:

14 minutes into the experiment on the first trail, the temperature is increasing where the lamp shines on the ground. Moisture is coming out of the soil in the first trial minute 33. Water level is decreasing, bubbles are forming on the bottom of the tinfoil at minute 47. In minute 7 of the third trail the carbon dioxide is disappearing.



Calculations:

What is the difference between the initial temperate and the ending temperature for each of the tests, on both soil and sand?

Trail 1 Soil: 79.7 degrees Fahrenheit - 72.5 degrees Fahrenheit = 6.2 degree increase

Trail 1 Sand: 84.1 degrees Fahrenheit - 71.5 degrees Fahrenheit = 12.6 degree increase

Trail 2 Soil: 71.6 degrees Fahrenheit - 71.5 degrees Fahrenheit = .1 degree increase

Trail 2 Sand: 72.4 degrees Fahrenheit - 72 degrees Fahrenheit = .4 degree increase

Trail 3 Soil: 80.3 degrees Fahrenheit - 71.5 degrees Fahrenheit = 8.8 degree increase

Trail 3 Sand: 85.1 degrees Fahrenheit - 69 degrees Fahrenheit = 16.1 degree increase

What is the range of temperatures in each of the trails for both sand and soil measurements?

Ranges	Trail 1	Trail 2	Trail 3
Soil Temperature	72.5 - 82 degrees	71.5 - 73.9 degrees	71.5 - 82.9 degrees
Sand Temperature	71.5 - 84.6 degrees	71.7 - 73.9 degrees	69 - 90.9 degrees

Questions To Consider:

Are there any significant similarities when comparing each of the gasses inserted on both soil and sand measurements?

How can these measurements relate to real life, and Climate Change on the global scale?

What are some of the alternate sources of energy, what do you think the most efficient is? Are the benefits worth the risks? Take into account the history each, and which might be the most accepted by the general public.

How have alternative sources of energy changed in the past twenty years?

If the such a temperature increase were to happen in the real world, what would be the affects on the planet?

Data Analysis & Results:

Environmental organizations and leaders really became strong in the sixty's and seventy's, which were mainly sparked by the set of problems that were found in Los Angeles, California. These problems mainly being smog, which is fog combined with smoke and other atmospheric pollutants, and acid rain. These two problems were dealt with very effectively, for instance affixing catalytic converters to the tail pipes of cars to solve the smog problem, and scrubbers to be affixed to smoke stacks for acid rain.

According to Michael Shellenberger author of "Break Through" a book about market oriented environmental solutions "Global Warming is a very different challenge, you can't stay with coal and oil as your fundamental energy source." He later goes on to say that the United States as a whole has to reduce it's emissions somewhere around 80% by 2050, and somewhere around 50% worldwide. And simply that there is no easy inexpensive technical solution, and it requires an acceleration of our transition to clean energy sources.

In other words it requires new sources not less of an old source. In an interview with the New York Times Michael Shellenberger also states "There is very good research showing that in the last 30 years, every time you double the production of solar panels the cost comes down about 20%, and experts are saying that if we invest between 50-200 billion dollars you could bring down the cost of solar to natural gas and coal." This is a solution that comes from a technology innovation, and not from pollution regulation. If we were to compare the amount of money it would take to research more efficient ways of using and industrializing solar power to the amount of money we are spending on foreign oil, it's 1/5th the cost to research solar power.

Another attractive alternative source of energy is nuclear power. In spite of what some people think, nuclear power plants are very safe, nothing is burned or exploded in the nuclear reactor. Here is a simple explanation of the process of generating power from nuclear reactors: the uranium fuel generates heat through a process called fission. This uranium is contained in solid pellets about the diameter of a piece of chalk and about half an inch long. These pellets are stacked inside long vertical tubes within the reactor. As certain atoms in the pellets are struck by atomic particles, they split to release particles of their own.

These particles, called neutrons, strike other atoms, splitting them. This sequence of one fission triggers others, and those trigger more, causing what is called a chain reaction. When the atoms split they create an enormous amount of heat. These rods are cooled with water, causing the water to turn into steam. This steam leaves the containment building which contains the most dangerous part of the power plant. The power plants containment building is completely concrete, to contain any accidents that may occur.

The steam that leaves the reactor drives the steam turbine, which spins a generator to produce power. In some power plants, the steam from the reactor goes through a secondary, intermediate heat exchanger to convert another loop of water to steam, which drives another turbine. The major challenge with nuclear power, is nuclear waste. During refueling, spent fuel rods are removed from the reactor and stored underwater at the plant site. The water cools the still warm fuel and also provides shielding from the radiation as it starts to decay.

However the material will remain radioactive for many years, which can cause many health problems to any people, fish, and most living organisms. The real problem is where to store it where it will not harm the outside environment. Greenpeace has protested the dumping of this radioactive material in the ocean. Yet another problem regarding nuclear power plants is the public view of them, mostly because of it's history. The worst nuclear accident to date happened in 1986 at Chernobyl, a nuclear power plant in the Ukraine.

This accident was not called by equipment failure, but human error. Operators deliberately bypassed safety systems to learn more about the plants operation. One of the reactors overheated and its water coolant flashed into steam. The hydrogen formed from the steam reacted with the graphite moderator to cause two explosions and a fire. Thirty-one people died trying to put out the fires and about 250 sustained severe radiation sickness. An estimated 2.2 million people will be affected over the years by the radioactive fallout.

Another error in the common believe of the public is that nuclear reactors can explode like an atomic bomb. But this is not true, the control rods that are inserted into the reactor are made of material that absorbs neutrons. It is called a control rod because it controls the amount of neutrons that initiate the fission, making an explosion like a nuclear bomb impossible. To sum up, there are some flaws in nuclear power.

Once again I mention that the main one is the disposal of nuclear waste. However, spent nuclear fuel is now being shipped to a federal storage facility, which can recycle more than 90% of the fuel, allowing it to be used again. I believe that nuclear power plants have the potential to be the new source of energy for the planet. However it may depend on the acceptance from the general public.

Wind Power may also be the next source of energy as well. Currently it is not being used to power much of the world, considering it accounts for only 1% of world-electricity use. But, wind power is plentiful, renewable, widely distributed, and clean. The main problem with wind power is that, of course, its not always windy, and it each windmill take up a lot of space. Further research in wind power actually has the potential to improve it. By reducing friction, causing the mill to spin faster and generate more electricity.

Many companies, homes, and schools have invested in solar power as an energy source. It has been used for handheld devices such as calculators, and chargers for other electronics. They can also power a variety of things from traffic lights, to satellites. The sun is an extremely powerful star, on a bright day the sun shines about 1,000 watts of energy per square meter on the planets surface. If we were to harness that energy we could easily power our homes, schools, and offices for free. The main problem with solar power is that solar panels are currently very expensive. However research could lower the price of solar power to the levels of natural gas and coal. Another small problem is storing the energy from solar panels to use at night, which requires batteries which would eventually have to be disposed of. We currently have no way of deposing of these batteries very efficiently.

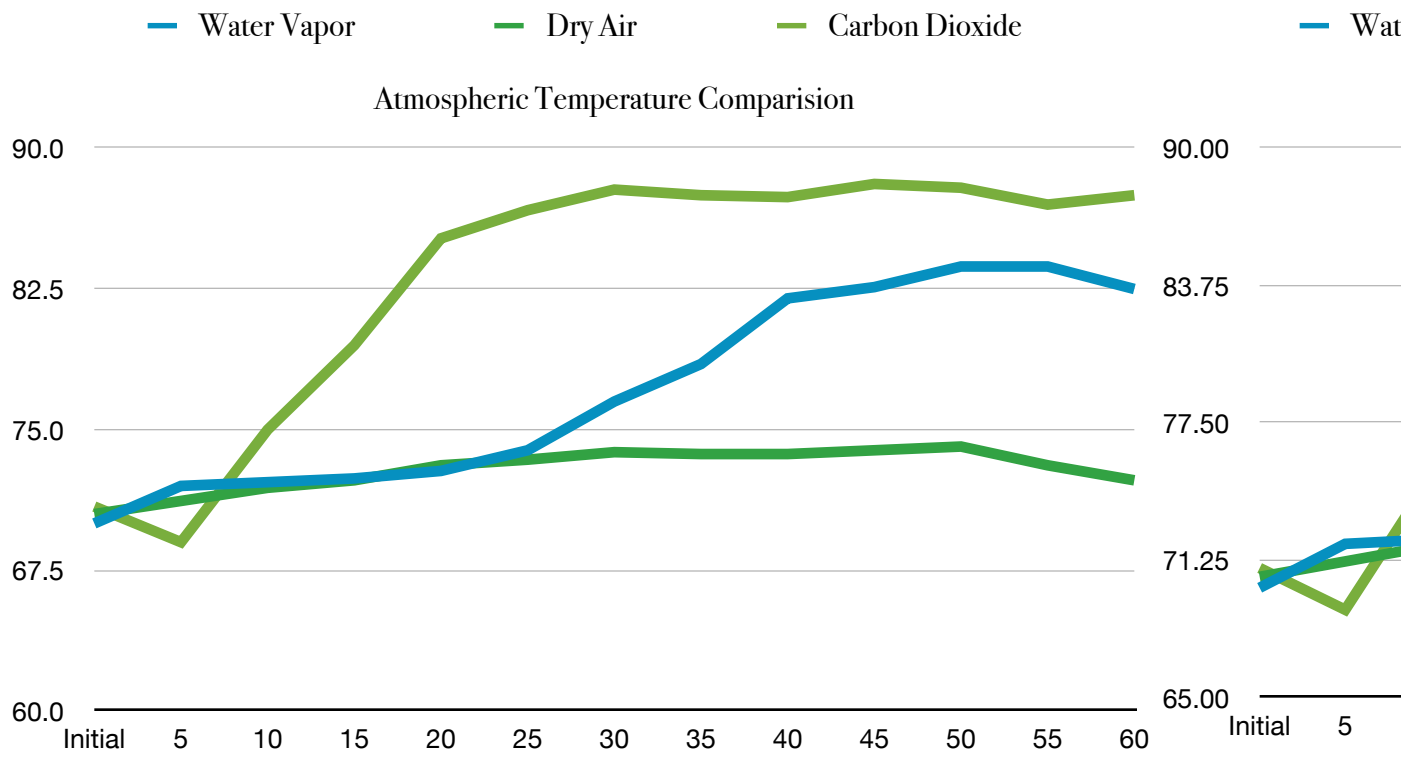
After passionately researching each of these alternative sources of energy, I found solar power to be the most efficient. However, I find the most realistic to be nuclear power. The reason I find solar power to be the most efficient is because not only is it very cheap to use after installation, it uses a source that will last for millions if not billions of years. The reason I find nuclear power to be the most realistic is because it currently accounts for over 20% of the worlds electricity. Uranium is becoming very plentiful in the 21st century, and it does not emit any carbon dioxide into the atmosphere.

In this lab I recorded atmospheric temperature as well as the ground temperature of an enclosed environment when introducing different greenhouse gasses. I began by constructing the most realistic environment possible. I then turned on the lamp, which was representing the sun in this recreation, and recorded to temperature every minute for five minutes. This was so that I could record how warm the tank would be normally with the lamp on.

Next I added water into the tank and spread out with tinfoil allowing a larger surface area, a larger surface area allows more of the water to become vapor. As I have noted earlier water vapor is a greenhouse gas, meaning that it should theoretically increase the temperature of the atmosphere, in order to better understand my data I plotted a graph:

Based on this graph it appears that I have successfully demonstrated the affect of water vapor on an environment. I did this by comparing the green line (normal dry air) with the blue line (water vapor), and at no point in this test was the temperature of the tank with normal dry air higher than it was with water vapor in it. This indicated that the water vapor had an affect on the temperature of the tank, supporting my hypothesis, as well as the fact that water vapor is a greenhouse gas.

After recording my results and observations I continued onto the next step of my procedure, which was to replace the water with dry ice. I did this because the dry ice volatilizes into carbon dioxide, which is also a greenhouse gas and is likely the most known about. This gas as well as the water vapor should theoretically increase the temperature of the tank. In order to better understand my data I plotted a graph that compares all the three gasses I used for testing:



This graph indicates that there was an increase of temperature within the environment. Something that is certainly worth noting is that there was a significant difference between the Carbon Dioxide trial and Water Vapor trial. This indicates that carbon dioxide could have more of an effect on an atmosphere than water vapor. This also supports my hypothesis, but may be a fairly new observation regarding the difference of temperatures conducted by previous studies.

Possible sources of error include a difference in the way the way the lamp was positioned over the fish tank. Inconsistencies of outside light, an interference of body heat. The lid of the tank not being properly positioned, thus releasing some of the gas or allowing outside gas to enter. Other possible sources of error include: Water spilling, amount of dry ice in the tank being to much or too little, and finally not reading the thermometer correctly.

These measurements relate to real life in that nuclear power plants release water vapor out of their cooling towers. Which is a greenhouse that could potentially warm the environment. However a term that is not mentioned nearly as much as global warming is global dimming. When we pump unhealthy gas into the atmosphere, usually there is charcoal, dirt, and many other harmful substances within it. In the atmosphere water particles attach themselves to these substances which theoretically prevents a portion of the sunlight from reaching the earth. This is the process of global dimming.

A real world example of this is after the attack on the world trade centers. Immediately after September 11th all international flights were grounded for three days. Which of course meant that their were no contrails in the sky, which mostly consist of water. A scientist decided to compare the temperatures of these days to the rest of the year as well as previous years. He found that the temperature for those three days only had increased by 3 degrees Fahrenheit. This is an extremely large temperature change and helps support the theory of global dimming.

Conclusion:

My hypothesis for the most part was not correct. I hypothesized that for each of the gasses I added to the tank the increase would be minimal, but it was not. The increase of temperature was far more than I hypothesized, about 45% more. I learned which out of the two greenhouse gases I tested had the largest effect on the atmosphere. I learned more about the pros and cons of nuclear power, solar power, and other alternative sources of energy. I learned how easily the atmosphere of an environment can be altered, and what types of affects that change can have on the environment. Most importantly I learned what is the best alternative source of fuel is, and how we could challenge the task at hand which is saving our planet from ourselves.

This lab did not trigger any additional questions.