Science Fair Logbook

By: Mannat Sidhu

Sept. 19 – Today was my first science fair meeting. We talked about the timeline for the year and discussed our fields of interest.

Sept. 26 – As of today, I had a meeting with Ms. Bretner (my science fair coordinator) about ideas as to what is a beneficial topic in terms of application, as well as ideas that are current (issue) in our world. In this meeting, we concluded to focus on environmental issues in our society and how we can prevent these problems.

Oct. 2 – Today I have decided on my question and topic for my science fair project. The question (problem) is; How can I further develop carbon capture technologies to benefit future generations? Our full problem is: "Nothing vast enters the life of mortals without a curse." (*Sophocles).* With their continued uses, transportation devices, home amenities, and environmental energies are negatively impacting the lifestyle of future generations of planet Earth. Non-renewable energy sources are producing immense amounts of carbon dioxide in our society, surpassing scientific restraints in our environment. Although this threat is constantly restated throughout society, individuals are not willing to interfere with their conveniences for a problem we have not yet seen the consequence of. With this, researchers and scientists are evaluating varying solutions to help abstain from these outcomes. Carbon capture technologies are human developed devices to help reduce our carbon footprint and rehabilitate the economic balance. As researchers examining our future, developing these technologies for efficiency would result in increased sustainability for future generations. Thus, our project studies how we can further develop the process of carbon capture to benefit our environment and future generations of our planet.

I also got my topic approved by Ms. Bretner, talked about excellent quality questions, and determined my project's main idea.

Oct. 3 – Today was my second science fair meeting. I met with my scientific coordinator and received more information on the marking rubrics and information on the overall science fair process. Today she requested my method to be completed within two weeks.

Oct. 7 – As of today, I reached out to Raman Gill, a woman who achieved Top 30 under 30, and is VP Corporate of Apar Energy. I also connected with Gurpreet Sawhney, president of Fracture Modeling Inc., who works with carbon capture and utilization. We had a formal conversation and discussed carbon capture and the positives and negatives of this process.

Raman Gill elaborated on her work experiences in terms of oil and gas and how this relates to creating pollution (CO_2). She talked about how this is a relevant topic, and first civilians should consider how much pollution they are producing, before pivoting to machines that can do so (Costs less money, is more practical for future generations).

In addition to this, Gurpreet Sawhney provided me with a small lecture briefly elaborating on his experiences with carbon capture. Previously in the week he attended a seminar on carbon capture utilization and storage (CCUS). He explained to me an analogy of what carbon capture really can do in a society that is continuously producing immense amounts of pollution (Described using analogy of garbage can being all the world's carbon, carbon capture being a square centimeter being pulled from it). From this I can conclude that it is beneficial, but how can I further it to be more efficient for future generations.

Oct. 12 - Today I wrote out my method as requested by Ms. Bretner;

Method:

- Defining scientific terms
  - [Carbon capture and sequestration (CCS), carbon dioxide removal (CDR), etc.]
- Research
  - What scientific processes are used (compression, solutions – how carbon is more soluble in water than air) and why?
  - How many operational facilities are there?
  - What is the cost of implementing carbon capture technologies, and how does this prevent the usage of carbon capture technologies?
    - The higher pricing of carbon capture and its labour used for storage can derail civilizations to want to implement this in their society. They may believe that because there is not enough testing (evidence), it is not functional (analogy to vaccines and the misbelief)
  - Diverse types of carbon capture and their benefits and efficiencies (pros, and cons)
  - What makes carbon sequestration successful?
  - What is the process of carbon sequestration, and what steps are necessary to do so?
  - Which processes are most effective for each country and what factors impact this result (climate, geography, technological advancements, etc.)
- Data Sets
  - Using real world evidence to convey and support the importance of this process and what will occur if we do/do not?
  - The promises countries have committed to net zero carbon by a certain year and their progress thus far (Chart – If they continue this route, will they or will they not achieve carbon neutrality?)
- Models of several types of Carbon Capture
  - Saskatchewan form of storing carbon (so we can use it again – connecting to reusing carbon as opposed to releasing more, as a beneficial and more efficient source to carbon capture)
- Now What?
  - After concluding what factors are the most effective in capturing carbon, how can I apply this to our real-life world to stabilize or potentially reduce carbon emissions?
  - It all comes back to what actions we are willing to take to benefit our economy for the betterment of future generations
- Various Sources
  - To ensure the quality of information, I am going to research through various sources
    - Raman Gill
    - Gurpreet Sawhney
    - David Attenborough Documentary: A Life on Our Planet

- Trusted Websites and Online Resources
- Books and Media Text from local libraries

Oct. 16 – Today I met with Ms. Bretner and got my method, and the format of my logbook approved. Here I analyzed my next steps in this project, and how to properly approach my research to create a strong basis for my project. I also reviewed the rubric, to see what the requirements are for a successful project.

Oct. 23 – Today was my Third Science Fair Meeting. As a group, we all talked about how important and crucial your method is. We also briefly went over the rubrics and looked at the tally sheet. Lastly, we looked at how we all need to get our CYSF accounts set up and do the basic info plus the ethics due care 2A form. She requested that the CYSF platform information listed above to be completed by October 31st.

Oct. 28 – Today I researched my first term: Carbon Capture Storage and Sequestration. I summarized my research into a paragraph, and used sources [1], [2], and [3];

Carbon Capture Utilization:

Carbon capture utilization and storage are a set of real-world technologies and methods for preventing carbon dioxide (CO_2) from entering our atmosphere by either safely injecting it deep underground in geological formations, consisting of sandstone reservoirs, or converting it into useful products. Different carbon dioxide uses lead to various levels of emissions reductions, depending on the specific use, and what fuels and other materials, if any, the CO_2 is displacing. Deploying carbon capture storage at a power plant or industrial facility entails three major steps; capture, transportation, and storage. One of the main uses of CO_2 is for enhanced oil recovery (EOR), a method of oil extraction that uses CO_2 and water to drive oil up the well.

Oct. 30 – Today I added a question to my background research focusing on the significance of carbon dioxide as important in our society. This supports my entire project, and the entire purpose of regulating carbon levels throughout our society.

Nov. 3 – Today I filled out our Basic Project Info on the CYSF platform. I had to decide on which topics I wanted to compete in. The main topic category is Life Sciences. All my project topics are Biochemistry, Earth Sciences, Environmental Sciences, and Life Sciences. Each of these topics is a crucial aspect to my project. I also had to provide a brief description of my project. It is; Carbon emissions are becoming a larger threat in our society. For my project I will be looking into how I can further develop carbon capture technologies for future generations. This brief description describes my goal and initiative for this project.

Nov 9. - I have completed the Ethics Due Care 2A form. First, I had to provide a purpose of my experiment or research; To investigate how I can further develop carbon capture technologies for future generations. I also had to form a description of our research study, which is;

Carbon emissions are becoming a larger threat in our society. Many countries have dedicated to net zero carbon emissions, with Canada promising to do so by 2050. Over the course of our research, I will be examining different ways that we extract carbon from our Canadian environment and increase the efficiency of the process for future generations. This research could help make our journey to net zero emissions more efficient and benefit future generations on earth.

I also had to identify the risk level that is associated with my project. There is a low risk, as there is no physical experiment for our project, because I am doing a research/study project.

Nov. 11 – Today I rephrased our problem to include our question, and state how it is a current (relevant) issue today. It states;

"Nothing vast enters the life of mortals without a curse." (*Sophocles).* With their continued uses, transportation devices, home amenities, and environmental energies are negatively impacting the lifestyle of future generations of planet Earth. Non-renewable energy sources are producing immense amounts of carbon dioxide in our society, surpassing scientific restraints in our environment. Although this threat is constantly restated throughout society, individuals are not willing to interfere with their conveniences for a problem we have not yet seen the consequence of. With this, researchers and scientists are evaluating varying solutions to help abstain from these outcomes. Carbon capture technologies are human developed devices to help reduce our carbon footprint and rehabilitate the economic balance. As researchers examining our future, developing these technologies for efficiency would result in increased sustainability for future generations. Thus, my project studies how I can further develop the process of carbon capture to benefit our environment and future generations of our planet.

Nov. 13 – Today I edited my method and wrote a more detailed evaluation for my progress. It states;

Research:

To initiate my research, I will begin by defining foreign correlated terms, and their significance throughout my project. This includes carbon capture and sequestration, carbon dioxide removal, and biomimicry. These terms are all related to carbon capture and the design process of machinery.

Following this, I will research further into the carbon capture progress throughout Canada as opposed to the world. During this, I can evaluate what strategies other nations are developing, and why they are effective for their country. This can relate to the countries' technological advancements, geological conditions, and climate change.

After analyzing the outside world, I can focus on our Main Research. Our main scientific research evaluates the production of carbon capture and the diverse machinery used across Canada. I will integrate the effectiveness of storing carbon, and how I can develop this process to efficiently absorb an increased rate of polluted gas for our environment sustainability's.

Data Collection and Interpretation:

To support my claim and evidence for efficiency development, I will collect and research properly cited data sheets and scholarly websites demonstrating my formulated conclusion. A prominent data set relating to my project is the countries commitment to net zero carbon by a certain year. Evaluating the effect of carbon capture technologies on this data will support my claim in the benefit of these technologies.

Now What?:

After concluding what modifications, I can develop to modernize capturing carbon, it is important to recognize how I can apply this to our real-life world to stabilize or potentially reduce carbon emissions. This will account for social issues to the project (ethics), including how our decisions to "step up" as a nation are a more sustainable force in balancing our economic emissions.

Various Sources:

To ensure the quality of my information, I am going to research through various sources of text and media. Throughout our project, I will access different media sources (documentaries) to evaluate different opinions. To continue this, I will read and examine different books and media text from libraries, as well as trusted websites and online resources. I also will be cooperating and interviewing Raman and Gurpreet Sawhney, who have vast experience within the oil and carbon capture industries.

Nov. 16 – Today I answered the question of why carbon is significant in our society. This helps me understand why I can't remove all of it and have to focus on sustaining the numbers. I used source [4] and [5];

Why is Carbon Significant in Our Society?

Without carbon, humanity would cease to exist on Earth. Despite the negative results of over usage for carbon, it remains a foundational piece in our environment. Carbon is a necessary greenhouse gas because it helps stabilize bonds with other elements and regulates the earth's temperature. Without carbon dioxide in our environment, the earth's temperature regulation would be –20°C, and thus no longer inhabitable for humans.

Nov. 20 – Today I defined the term biomimicry, and recognized how I can use this method to implement into my own research and development. I used sources [6], [7], and [8];

Biomimetics (Biomimicry) is the emulation of natural formed structures, systems or models into human methods. The term is derived for solving complex human problems using natural methods. Scientists use this process to inspire, advance and validate human developments.
Biomimicry in carbon capture is from the function of how the ocean controls levels of carbon in our atmosphere. Our bodies of water can absorb 30% of emissions released each year, using an intricate system of organisms and abiotic elements. These parts function together to capture most of the carbon emissions into the atmosphere and control global warming in the environment.

Nov. 21 – Today I interviewed Raman Gill Sawhney and Gurpreet Sawhney from Fracmod Engineering. This elaborated on my knowledge and ensured that I had reliable information as Raman Gill and Gurpreet Sawhney are professionals in this field.

Nov. 24 – Today I watched David Attenborough's documentary, A Life on Our Planet. In this documentary, I noted key ideas relating to carbon documentary. The film summarizes how the evolution of society has set humanity at ease but has corrupted our home environment. From this, I also recorded the data described every few decades and how our population, carbon per million, and remaining wilderness statistics have evolved over time.

Nov. 27 – I summarized the statistics noted from the David Attenbourough documentary into tables;

David Attenborough: A Life on Our Planet Data

World Population:

Year:	**Population:**
1937	2.3 Billion
1954	2.7 Billion
1960	3.0 Billion
1978	4.3 Billion
1997	5.9 Billion
2020	7.8 Billion

Carbon in Atmosphere:

Year:	**Carbon (Parts Per Million):**
1937	280 PPM
1954	310 PPM
1960	315 PPM
1978	335 PPM
1997	360 PPM
2020	415 PPM

Remaining Wilderness:

Year:	**Remaining Wilderness (%):**
1937	66%
1954	64%
1960	62%
1978	55%
1997	46%
2020	35%

Dec. 27 – Today I have defined Renewable Energy as a part of our research.

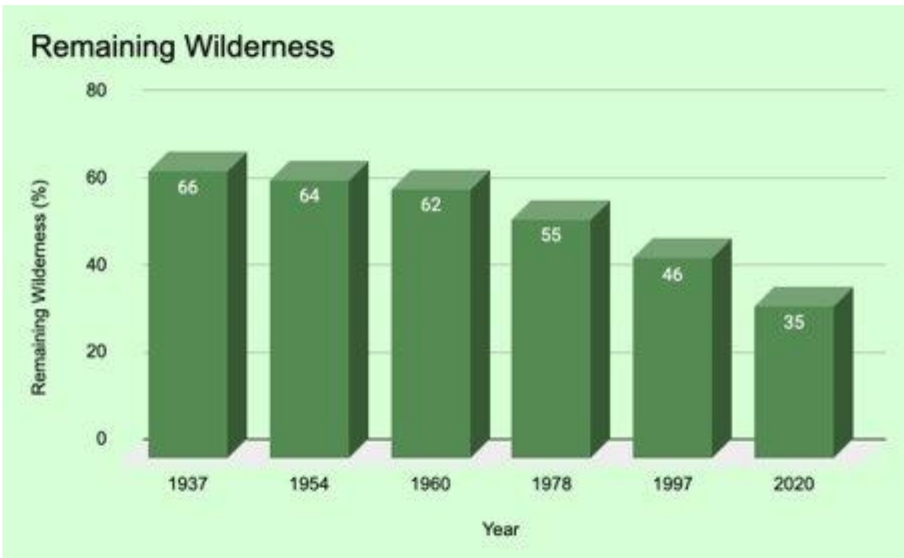
Renewable Energy:

Renewable energy is derived from natural resources replenished at a higher rate than consumed. Generating renewable energy creates far lower emissions than burning fossil fuels. Transitioning from fossil fuels, which currently account for a large share of emissions, to renewable energy is key to addressing the climate crisis. For example, sunlight and wind are sources that are constantly being replenished. Which is why there are renewable energy sources. Fossil fuels, such as coal, oil, and gas are non-renewable and take many years to form. When fossil fuels are burned to produce energy, this is what causes harmful greenhouse gases, such as carbon dioxide. (Sources; [10] and [11]).

Additionally, I have converted the tables from the David Attenborough: A Life on Our Planet documentary. The first graph is:

The second graph for the carbon in our atmosphere is:

The third and final graph from the documentary is:



These graphs show how much our planet is being damaged by human effects. The graphs visually display this.

For my research we answered the question; What is our current method of carbon capture?

My answer is:

Carbon Capture Storage and Sequestration is the process of extracting carbon dioxide from the air to be stored underground or utilized in facilities. This process helps remove any carbon particles contaminating the air, benefiting the environment and our health. As it is a relatively new technology, scientists continue to evaluate new methods and ideas when designing new technologies or chemicals to absorb carbon dioxide from the atmosphere.
With our current progressions, we have analyzed two different routes in capturing carbon. We have evaluated physical extraction of carbon, through the process of compression and solubility in different content, as opposed to the newfound method of chemical extraction, using enzymes to capture carbon molecules and convert them to carbonate. Other methods have been researched that are specific to a location's characteristics and features, such as hydrogen conversion and direct air capture.
[12], [13], [14], [15], [16], [17]

I have also explained one of the methods of carbon capture called physical extraction:
Physical Extraction focuses on machinery intaking carbon molecules and compressing them via pipelines to be stored in geological formations underground. Carbon capture industries originate with physical extraction by constructing large plants to inhale high amounts of carbon to process through to other facilities for usage or storage.
Physical carbon sequestration progresses over a three-step method of capturing carbon dioxide, transporting it through piping and cumulating underground.

- Step 1: Capturing the Carbon Molecules
- Step 2: Compressing and Transporting via Pipelines.
- Step 3: Collecting the Carbon Dioxide as a Supercritical Fluid to store in Geological Formations

Sources; 12, 13, 14, 15, and 16

Additionally, I looked at the first step of physical extraction: capturing the carbon molecules:
Physical carbon extraction focuses on using different scientific processes, to remove or "scrub" any carbon molecules from the air. Physical removal is initiated with the intaking of carbon dioxide and processing through to piping. It is typically removed from the air using absorption – physical and chemical solvents, distillation, and membrane contractors, but primarily depends on the scientific setting of where the carbon is being removed. It then can be stored underground in geological formations where it remains permanently.
This process can be completed using three varying methods determined by location, city needs and preferences, and features. Post – combustion, pre – combustion, and oxyfuel combustion are all differing processes used to capture carbon from the atmosphere. (Sources; 14, 15)

I spent time finding reliable resources for our research.

Dec. 28 – Today I looked into post combustion and its significance that it could make in our environment: Post combustion is the carbon removal process where the molecules are absorbed and removed from flue gas released from power plant facilities. It is recognized by most companies to be beneficial as it can retrofit to previously constructed plants.
The released emissions from the plant are transported via pipelines to a desulfurization unit ("scrubber") where sulfur dioxide (SO_2) is removed. In a factory without advancements, the industrial gases would be released into the atmosphere at this state. With carbon capture technologies, the flue gas can then be transported to a cooler. This allows the carbon dioxide to go through the process of cooling carbon to a state where it can be liquified and separated from the other exhaust gas. Then it is transported to an absorber where a solvent, comprising of an anime that reacts only to carbon dioxide (monoethanolamide), dissolves the carbon dioxide to create a mixture. The clean exhaust gas can then be released. The carbon dioxide mixture travels to the regenerator to distinguish the carbon dioxide from the solvent used. The pure carbon can then travel to sequestration plants for storage, and the solvent can be recycled to be used again in the absorber.
The negatives of post combustion revolve around the condition of the flue or industry gases and the pressure that it required to capture carbon from the atmosphere. As flue gas has a relatively low partial pressure, the carbon dioxide enlists more pressure from the machinery. This requires more electrical energy and maintenance than other machinery. The carbon is then extracted in a dilute state (~5-15% Carbon Dioxide Concentration), and at a low pressure.
Sources; [22], [23], [24], [25], [26], and [27]

I started to look at pre–combustion and its significance to our society and environment. Here's what I found today: Pre combustion is the process of extracting carbon dioxide before fuel combustion. Pre combustion gasifies the waste produced to create a synthetic gas mixture of hydrogen, carbon monoxide, carbon dioxide, and smaller percentages of substances, such as methane gas.

Additionally, I have started our section on Net Zero: What initiatives has Calgary taken, or should take? The first question for this section is, How is Calgary changing more policies to be more "green":

The city of Calgary has agreed to work together to conserve, protect, and enhance the environment. This means that they will comply with legislation, conserve resources, prevent pollution, and continually improve our environmental performance. One of the policies that the City of Calgary changed to be more green is to "Ensure City operations, including the work of contractors, comply with environmental legislation, standards and other environmental requirements," stated in the City of Calgary environmental

policy. They are changing the policies in a way that is more sustainable and eco-friendlier to our environment. Although, it will be challenging reach these goals that Calgary has set, Calgary has stated that they are ready for the challenge. According to the timeline on the Calgary Climate Strategy, they have displayed their journey so far. Starting with getting the strategy and idea approved, then developing a plan and budgeting deliberations, that last step that they have completed is the council deliberations for the budgets and plan from 2023-2026. They will also be renovating all City owned buildings, to reduce waste, conserve water, and increase energy efficiency. This process shows that these policies may take a while to take effect, but when it starts to make a difference, it certainly will immensely.
[17], [18], [19]

The second question in this section that I worked on today is, How is Calgary lowering its Carbon Dioxide emissions:

Calgary describes the process of reducing carbon and other greenhouse gases, as net zero emissions. The City of Calgary Climate Strategy says, “Net zero means cutting greenhouse gas emissions to as close to zero as possible.” The biggest component that Calgary is using to lower the carbon dioxide emissions is by adapting to our changing climate. Climate adaptations is referring to actions that reduce the negative impact of climate change, while taking advantage developing opportunities. The promises that Calgary has made to reduce greenhouse gases is upgrading homes, switching to zero emission vehicles, and removing emissions through planting trees or other forms of carbon capture. Carbon capture utilization and storage are a set of real-world technologies and methods for preventing carbon dioxide (CO_2) from entering our atmosphere by either safely injecting it deep underground in geological formations, consisting of sandstone reservoirs, or converting it into useful products. After looking at different calculations, “Over the lifetime of this project, the City of Calgary will see a cumulative reduction of about 200, 000 tons of greenhouse gas emissions - equivalent to removing approximately 61, 000 cars off the road for one year,” states the government of Canada. The City of Calgary Climate Strategy also states that “Calgarians are already upgrading and replacing their windows, adding higher efficiency furnaces and insulation as well as purchasing electric and low emission vehicles. Their decisions for better efficiencies contribute to our city moving towards net zero.” This shows how many initiatives Calgarians are taking for a more sustainable and eco-friendly future.
[17], [18], [19], [20]

I also looked at multiple graphs for net zero. The first graph I examined is Net Zero opportunities in Alberta:

The only benefit for going net zero is not just a more eco – friendly environment, but also more opportunities for Albertans. If Albertans take carbon capture initiatives, it will open more career and job options for Albertans and will strengthen the economy. This graph displays how many new opportunities will open for Albertans from 2020 – 2050. The red areas on the graph represent the net – zero pathway that Alberta is attempting to follow. The grey areas at the bottom of the graph represent business as usual in Alberta. As you can see from the graph Alberta has proven and stated that this acceleration will occur by 2050.
[17], [21]

The second graph we analyzed was on Net Zero: Calgary’s Emissions Goal:


This graph represents Calgary's Greenhouse gas emission goal. The Calgary Council has explained how they want to keep a "baseline emission" for years to come. The line graph shows how each year in the past starting from 2019 the emissions decreased from 2019 until they presume 2024. Then using their climate strategy they hope to keep a "baseline emission" continuing until 2050. A baseline emission means that we are only releasing the amount of greenhouse gases that we need, while having a good balance with sustaining our environment. You can identify a baseline emission on the graph, when you see a straight blue line. This graph represents Calgary's net zero scenario.
[17], [28]

The third graph I examined is on Calgary’s greenhouse gas emission saving goals:

This graph shows Calgary's emission saving goals for each sector of our everyday lives from 2019 – 2050. The blue sector is the transportation savings that Calgary will be willing to take. The yellow sector represents the residential savings that the Calgary Council presumes Calgarians will be willing to take. The red sector represents the commercial savings that would help lead to a net zero environment. As you can see the largest sector is the residential savings, this shows that each and every Calgarians must take an initiative for a more sustainable future for Calgary. If we all save emissions from commercial, residential, and transport savings we can look forward to a more sustainable future. We cannot be sure if these savings will be enough for a net zero environment, which is why carbon capture technologies must be introduced to our society.
[17], [28]

Dec. 30 – Today I finished researching precombustion and formatted my knowledge in paragraph form:
Pre combustion is the process of extracting carbon dioxide before fuel combustion. After burning a feedstock material, such as coal, oil and gas, the waste is then processed to capture and transport the carbon dioxide produced.
Industries continue production but before combusting waste material, the plant must undergo removing carbon dioxide. Firstly, the process removes sulfur from the material preventing its formation during fuel burning. Pre combustion then occurs by gasifying the waste to create a syngas mixture of hydrogen, carbon monoxide, carbon dioxide, and smaller percentages of substances, such as methane gas. The synthetic gas can then go through a water shift, converting the CO and $H_2$0 to a rich mixture of CO_2 and H_2. The CO_2 is separated and sequestered similarly to the methods of post – combustion, while the H_2 can be combusted powering a gas turbine. The steam produced from the H_2 starts a generator, which powers a steam turbine that provides electrical energy to the plant.
During Pre – Combustion, the carbon dioxide being removed is at a higher concentration (15 – 50% of the Mixture) at the synthetic gas stream. It is also removed at a higher pressure, decreasing the amount of energy required to maintain capture. With the positive benefits of pre – combustion, there is also the increased cost of implementing gasification methods as well as the adaptations that are necessary to construct the machinery for this carbon removal process.
Sources; [22], [29], [30], and [31]

I also took time to edit my previous work in order to ensure my understanding and my quality of work.
Dec. 31 – Today I worked on oxyfuel combustion. I looked into why it is so important to know about and what it is: Oxyfuel combustion is the process of removing carbon dioxide while it is combusted in a furnace with pure oxygen. This process would remove a high concentration of carbon dioxide (40 – 90% of Pure CO_2) from consistent fuel combustion.
Air flows through piping into the Air Separation Unit (ASU) where using a cryogenic process of cooling and liquifying the air oxygen and nitrogen can be separated. This allows for nitrogen to be emitted through the unit while oxygen flows through the combustion unit into the boiler. While entering the combustion unit, the oxygen is being combined with recycled flue gas (Co2 and water vapour). After enduring the ASU and being mixed with flue gas, the mixture approaches the Combustion Unit (CU). At this stage, the fuel is inserted into the boiler and is burned with a composition of oxygen and recycled flue gas (CO_2 and water vapor). This method replaces air as an oxidant gas in the boiler. Steam produced from this combustion is used to power a steam turbine, for the plant. Following the CU, the burned carbon dioxide mixture then endures particle removal. This method is a filter removing particulate matter produced after combustion, using electrostatic precipitators or fabric filters. Flue gas filtered from this process can then be recycled for more usages. The remaining material is processed through desulfurization to remove sulfur and other remaining toxins. The carbon dioxide is then cooled and condensed to be transported for sequestration.
Oxyfuel combustion is researched by scientists to have the highest efficiency in terms of the amount of carbon captured and mitigating climate change. Researchers recognize the size of the total unit, the lack of solvent usage, high carbon concentration and potential retrofitting towards existing plants. Important limitations of its implementation include high energy usage (388 MWe), operation at sub – atmospheric

pressures to prevent contamination and leakage and difficulty to commercialize and spread the method amongst other facilities (cost and material dependency).
Sources; [22], [32], [33], [34], [35], [36], and [37]

Jan. 1 – Today I defined gasification:
Gasification is a technology that converts material containing carbon, such as coal, biomass, and waste, into synthetic gas. It is used to produce electricity and other valuable products like chemicals, fertilizers, and fuels. Gasification does not involve or incorporate combustion. It also uses little or no oxygen to directly convert carbon-based materials into synthetic gas or syngas. The first ever gasification plants were built in the 18th century to produce town gas for lighting. This process was later applied industrially to generate heat and power. The benefits of gasification include environmental and economic advantages, producing transportation fuels and electricity, and it is reliable technology. Thus, we can see that gasification has significant benefits to our environment and society
Sources; [38]

Additionally, I have defined biomass as a key term:
Biomass is a renewable organic material from plants and animals. Biomass is a significant fuel in different countries, especially for heating and cooking in developing countries. Using biomass fuels for electricity and transportation generation is increasing in several developed countries to reduce carbon dioxide and greenhouse gas emissions from fossil fuel use. It is regarded as a potential energy source. It is organic matter that can be converted to fuel. Sources; [38] and [39]

As well as this, I researched step two of the physical extraction carbon capture process:
After the differing methods of physical extracting carbon from the air, the material is compressed in order to be transported. Compressing the material to pressures of 1500 – 2000 pounds per square inch (psi) allows for it to be moved while taking up minimal spacing in deep space formations. It is transported in primarily a fluid state, but with new scientific studies the potential of solid carbon storage is being introduced.
When transporting carbon in a fluid state, the movement is reliant on pressure. Carbon dioxide can endure liquification during compression, allowing it flow through pipage more effectively to storage. By pressurizing the carbon dioxide beyond its critical point, the material becomes a supercritical fluid. This is when its viscosity of the fluid is the same as a gas, with the density of a liquid. Carbon dioxide can then be transported easily through the pipes to drilling and storage foundations.
Using new methods of liquid metal as catalysts, carbon dioxide can also be pressured to a solid state when transporting for storage. With injections of the liquid metal, the gas molecules in carbon dioxide separate into microscopic flakes of pure carbon. As well as this, new technologies from Australia's Royal Melbourne Institute of Technology (RMIT) show a new mineralization process compressing carbon into a solid material like coal. This would allow it to be stored underground (In deep geological formations) in a cyclical matter in accordance to how it was removed.
With the differing methods of compressing the gas into a transportable substance, the material can flow through an extensive circuit of piping to different CCUS facilities, to then be inserted into geological formations, or underneath the ocean floor.
Sources; [40], [41], [42], [43], [44], [45] and [46]

Jan. 2 – Today I researched step three of the physical extraction process and learned about different ways I can utilize carbon:
In the concluding step of the carbon capture process, the captured carbon is sequestered. Carbon is pumped through surface level injection wells as a supercritical fluid into either 'unmineable' coal seams, enhanced oil recovery sites, geological formations (basins) or depleted oil and gas reservoirs.
Coal seams within the earth that are incapable of being mined can act as a storage unit for carbon dioxide. The coal (volcanic rock) is semi permeable, allowing carbon dioxide to be absorbed (adhered) to the stone. In this process of injection, the carbon dioxide is permanently stored at the expense of coal seam methane (CH_4). The methane that is released from the coal can then be recovered and utilized as a fuel source.

Carbon can also be injected into Enhanced Oil Recovery (EOR) sites to increase oil production in declining fields. This method is a more established within the oil and gas industry as different location in the United States have already worked with this process. Recent studies have reflected 30 – 50 million tonnes of carbon in the United States has been pumped into mature oil fields, enhancing their development. Although, a negative of this process is the subsequent oil burning within time, and how produced emissions offset any carbon reduction.

Saline formations act as a sponge storing carbon dioxide within the pores of the aquifer. The geological formations are saturated with brine (saltwater) consist of a water permeable exterior. The rock has varied holes (Millimeters in diameter) that are connected, permitting the movement of carbon dioxide throughout the formation. As the carbon dioxide is more buoyant than pre – existing fluid in the rock, portions begin to gravitate upward. To prevent leakage from the carbon dioxide, a geochemical trapping mechanism of a non – permeable top seal is used to contain the supercritical fluid. With time and weathering of the rock, different reactions can occur within this storage. With the saline aquifers pre – existing fluid, carbon dioxide can endure Solution Trapping in which it dissolve into the foreign the solvent in the rock. Carbon can also endure Residual Trapping where the substance is contained within the tiny pores of the rock. Another reaction of the capture could result in Mineral Trapping, where carbon dioxide is permanently stored. In this process, the carbon and iron (Fe), magnesium (Mg), and calcium (Ca) react to slowly develop a new mineral composed of dissolved carbon and the saline aquifer formation. This material could be researched and potentially utilized in our economy, thus allowing us to reuse captured CO_2.

Carbon dioxide can also be pumped into depleted oil and gas reservoirs. These sites are no longer economically utilized in oil and gas production. Although with their established trapping and storage characteristics displayed during prior usage, scientists have recorded them to be effective storage units for carbon.

Sources; [47], [48], [49], [50] and [51]

Despite societal concerns, research recognizes no scientific concerns in terms of trapping carbon dioxide underground. The vast underground potential storage sites and resources have been calculated to exceed the space needed to meet climate targets. Countries committing to net zero carbon have analyzed their geological formations and surface conditions to preserve the space for carbon capture storage.

To ensure the progression and safety of the carbon capture storage sites, machines to monitor, measure and verify injected carbon dioxide are being utilized above and within carbon storage sites. A modified thermal imager has been utilized to monitor any potential leakage with carbon capture. Using infrared data to develop an electronic image of the storage site, scientists can evaluate the progression of the storage, observe any chemical reactions of the CO_2 and prevent any hazardous conditions. Seismic technologies have also been integrated into carbon capture storage with the potential harms of high injections of carbon. These technologies provide seismic sensors, data acquisition systems, reservoir monitoring solutions and leak detection systems to sequestration ensuring the safety of carbon injection. A current seismic monitoring technology is SADAR, which classifies changes to reservoirs in a current timeframe, which permits immediate action for any alterations or potential hazards of the storage unit. As well as SADAR, there is Optoseis PRM that records detailed changes in the storage sites, and Insight Fiber Optic that allows the sites to be monitored at multiple levels, in a current time frame. Researchers have also developed technologies to assess territory for potential carbon capture storage. Regional Screening Devices have been developed to assess the gross features of potential saline aquifers as future storage sites. The Storage Play Quality Index (SPQI) technologies are applied to global seismic and geoscience databases (available proprietary data) to analyze whether the tested sites has the capabilities of storing and containing carbon dioxide.

CCUS facilities are studying different methods for carbon usage within our society. Direct usage of carbon can focus on recycling the material as a solvent in EOR plants, and usage in supercritical fluid state in machinery. Carbon studies have also been conducted in developing differing ways to convert the carbon into materials, fuels and chemicals. Studies and tests have been processed in modifying the material to produce a concrete substitute. As well as this, varying compositions have been tested to reuse carbon as a biofuel (bio methane and liquid fuels).

Sources; [47], [48], [49], [50], [51], [52], [53], [54], and [55]

Jan. 4 – Today I looked at the different types of sequestration. The first type of sequestration is biological sequestration; In biological sequestration, the vegetation and aquatic life in our natural environment is the storage unit. Natural methods such as photosynthesis, ocean acidification, plant and soil absorption sequester roughly half of our carbon dioxide.
The oceans in our world absorb 25% of the carbon dioxide released into the atmosphere yearly. The ocean dissolves carbon dioxide with the polar bonds between H_20 and CO_2. The two substances react to form carbonic acid (H_2CO_3). This compound breaks down to a hydrogen ion (H^+) and bicarbonate (HCO_3-). Although this dissolves carbon dioxide in our atmosphere, this ions produced from this compound reaction decrease saltwater pH, thus acidifying the ocean. The ocean absorbing excess heat and greenhouse emissions slows down ocean circulation. With unregulated ocean currents, the ocean's temperature will begin to increase.
The forests, grasslands, soil and rangelands are large factors maintaining our atmospheric conditions. Carbon can be sequestered in soil by photosynthesis and plant material as soil organic carbon (SOC). Also, forests are large storage sites for carbon dioxide. Mature trees can absorb around fifty pounds of carbon annually, and the substance is permanently stored in the tree's fibers (biomass). Although with increased deforestation, any decomposition of the tree (natural fires, or decaying) releases all the captured carbon into the environment, thus offsetting any storage. With this, grasslands and rangelands are important units of carbon storage. To prevent re-releasing carbon into the atmosphere, grasslands sequester the carbon into their roots. This decreases how much carbon dioxide that is stored, but ultimately is a more resilient site for storage.

Sources; [60], and [61]

The second type of sequestration is geological sequestration; Geological sequestration is the process of storing carbon dioxide in underground geological formations (rock and coal) and saline aquifers.
This method of sequestration injects carbon dioxide into saline aquifers, using surface level pumps. The carbon is transported as a supercritical fluid and is stored in the tiny pores of the rocks. In this process, the carbon may undergo certain chemical reactions with the pre – existing fluid in the rock formation. These reactions may change the composition of the carbon or solidify its storage within the rock.
With most carbon capture processes, geological sequestration is used to store carbon that is removed from power plants. Removed carbon is compressed into a supercritical fluid state, in which it is pumped into saline aquifers or unmined coal to be stored.
Studies are still researching the offsetting properties of geological sequestration, including the energy of the machinery used to pumped the substance into the underground formations.
Sources; [60], and [61]

The third type of sequestration is technological sequestration; Technological sequestration is a new idea fostered by scientists attempting to directly capture carbon from the air. This idea also involves the potential usage of carbon dioxide as a resource in our economy.
Using newfound technologies, scientists are focusing on Direct Air Capture (DAC) to extract carbon from the air without an extensive process. Engineered Molecules, with correlation to the body's STEM cells, are adaptive to the environment that they are in. These molecules act as a filter, a and can change shape by creating new kinds of compounds singling out carbon dioxide. These technologies continue to be processed and altered to maximize efficiency.
A negative to capturing carbon directly from the air is the extensive cost to implement on a large scale. The materials are costly, and the process is energy intensive, making it a difficult process to develop with future generations.
Sources; [60]

Additionally, I started looking at Canada's progression towards carbon capture, and the carbon dioxide emissions within Canada. First, we worked on the carbon dioxide storage potential in North America;

This diagram demonstrates the carbon dioxide storage potential within North America. The black dots are the late-life oilfields, the blue sections are saline aquifers, and the yellow sections are unmined coal. As you can see there are very minimal sections with unmined coal, and the only one is in the United States near Missouri and Illionois. Each of these three sections show high potential and the correct characteristics for carbon capture technologies. As, late life oilfields are decreasing in production, they have the potential to store carbon dioxide. The late life oilfields can also relate to depleted oil and gas reservoirs, since these can also be potential storage sites for carbon. Saline aquifers also have the characteristics to store carbon dioxide. As they are geological formations consisting of water permeable rocks that are saturated with salt water called brine. Carbon Dioxide that has been pressurized to a phase between gas and liquid, may be injected into a saline aquifer where it may dissolve in the brine. The last and final section is unmined coal, which is a type of coal that is too dangerous to mine but instead can store carbon dioxide. As we can see from the general colouring of the diagram there is not much carbon capture potential in Eastern Canada, Nothern Canada, Mexico, and Alaska.

Sources; [47], [48], [49], [50], [51], [57], and [62]

Today I also looked at the Canadian Emissions by Sector;

This graph shows the Canadian emissions by sector. There are eight sectors incorporated within this graph. There is the oil and gas, waste transport, agriculture, heavy industry, buildings, electricity, and other. The level of carbon dioxide is measured in million metric tonnes of carbon dioxide equivalents, which is abbreviated as MMT CO2E. As we can tell Canada has the most emissions of carbon dioxide from electricity. The second most from heavy industry. The third most from transportation. The fourth from oil and gas. The fifth from buildings, the sixth from agriculture. The seventh most from waste, and the eighth most from other. This graph is very significant as to why we need to start reducing our carbon dioxide emissions, by slowly reducing from each sector. From the graph we can see that over the years, Canada's emissions have increased. Canada has the highest level of emissions in roughly 2007. We need to sustain our environment, and if our emissions are increasing, we also need to increase our carbon capture levels.

Sources; [57] and [59]

The last graph that I looked at today was on the Annual CO_2 Emissions by World Region;

This graph shows the annual carbon dioxide emissions by world region. The carbon dioxide is measured in millions of tonnes. The geography of carbon dioxide emissions is critical for understanding where intervention efforts should be focused. More developed nations or regions typically have a higher amount of carbon dioxide emissions. Although, emerging economies are increasing their share. This regional data can inform targeted policies, international collaborations, and technological deployments aimed at reducing emissions. As we can see from the graph our carbon dioxide emissions have increased immensely over the years on a global scale. Europe has a much lower carbon dioxide level, compared to more developed economies such as Oceania and Asia. The highest level of carbon dioxide emissions is from international transportation. Thus, we should aim to reduce our carbon dioxide emissions.
Sources; [65]

Jan. 10 – Today I had my fourth science fair meeting. We briefly talked about the trifolds and presentations. We also discussed the date of our school science fair which will take place on February 23.

Feb. 3 – Today I focused on chemical extraction: Chemical extraction is a novel technology developed within carbon capture innovations using chemical processes and reactions to maximize the extracted concentration of carbon dioxide. Scientists have founded these two methods and stated that with extensive research and testing they could have increased impact on the mitigation of carbon dioxide in our society. These processes are also being designed to integrate the utilization of carbon dioxide, and turn the gas into a property that can be reused or stored in a more efficient manner.

Methods introduced within chemical extraction include:

1. Chemical Looping
2. Enzymatic Carbon Capture

I looked into enzymatic carbon capture in chemical extraction: Enzymatic carbon dioxide fixation is a metabolic reactions that captures inorganic carbon from the atmosphere and converts it into organic biomass via enzymatic carboxylation's. This combination of carbon monoxide and organic compounds is the primary mechanism of carbon release and storage within nature.

Using biomimetic methods, scientists have evaluated that the abundant enzymes in our environment can be converted into acrylate, the material basis of polymer products. Researching the process of photosynthesis curated a catalyzing enzyme, Ribulose bisphosphate carboxylase oxygenase (RuBisCo). With carbon dioxide form as a linear molecule, you cannot oxidize it further. This portrays that by applying electrons to the substance, it will form a carboxylic acid.

This enzyme binds electrons to this component to form carboxylic acid. The enzyme is not as targeted and is a very time-consuming process. With this, if the enzyme contacts another molecule more abundant than carbon (oxygen), it will bind with that substance.

Scientists in this industry are researching and testing the first step to enzymatic carbon capture, reviewing how to alter the enzyme so it only is attracted to carbon. This would allow the carbon particles in our atmosphere to be utilized and recycled to a product that emits high amounts of carbon dioxide. With appropriate alterations to the enzyme, the properties of the substance could constitute up to 50% of the soluble proteins in a leaf.

Sources; [66], [67] and [68]

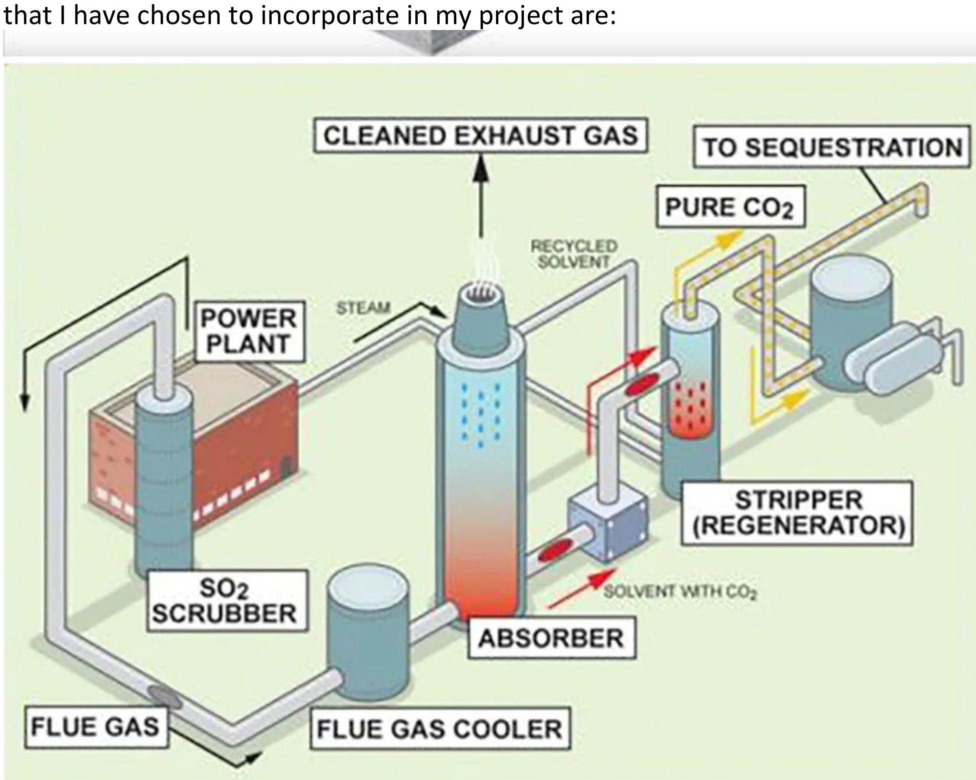
I also looked at chemical looping in chemical extraction:
Chemical Looping is an advanced chemical form of oxyfuel carbon combustion. It uses two or more reactions to perform the oxidation of hydrocarbon-based fuels. Using this process eliminates the need for an Air Separation Unit (ASU) by using these chemical reactions to produce oxygen on site. Pivoting to the alternative oxygen separation method of reduction and oxidation could immensely reduce the large capital of energy and costs.

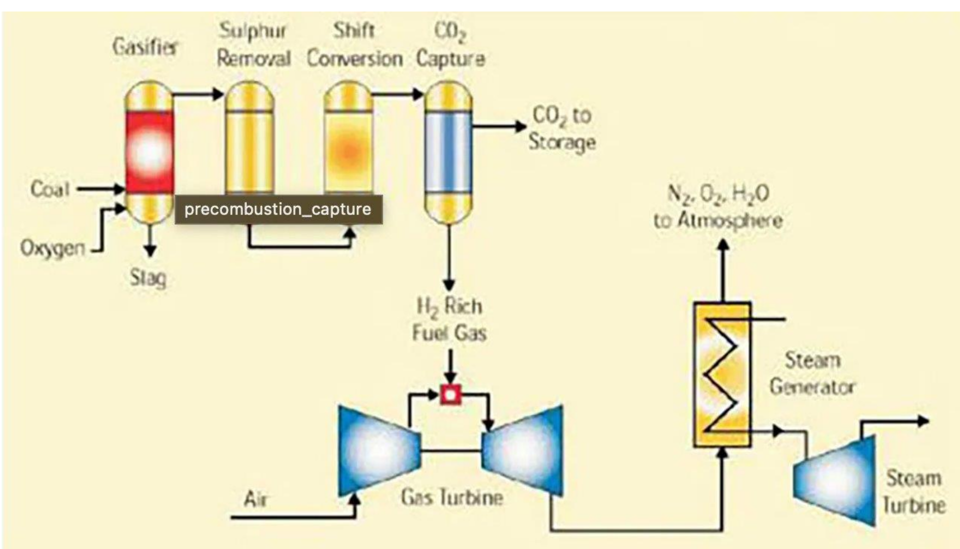
In this process, flue gas from a thermal power plant travels to a set of two looping reactors. It enters through the piping into the air reactor of the dual fluidized-bed reactor systems, and the oxygen carrier is oxidized. Depleted air leaves through this reactor to prevent confliction between fluids. Subsequently, the metal oxide sorbents (magnesium oxide, calcium oxide, zeolite, activated charcoal and silica) and oxygen (produced by the air reactor) are circulated into the fuel reactor for combustion to occur. The oxygen and metal oxide bind to create a stong filtering unit for the carbon dioxide, allowing for high concentration of the fluid. Fueled by CH_4, the combustion burns the substances and separates the carbon dioxide and hydrogen from the reduced metal oxide. Similarly to the process of oxy-fuel, the hydrogen is filtered out and used to power turbines. To continue the looping, the reduced metal is cycled back to the air reactor to continue the process again.

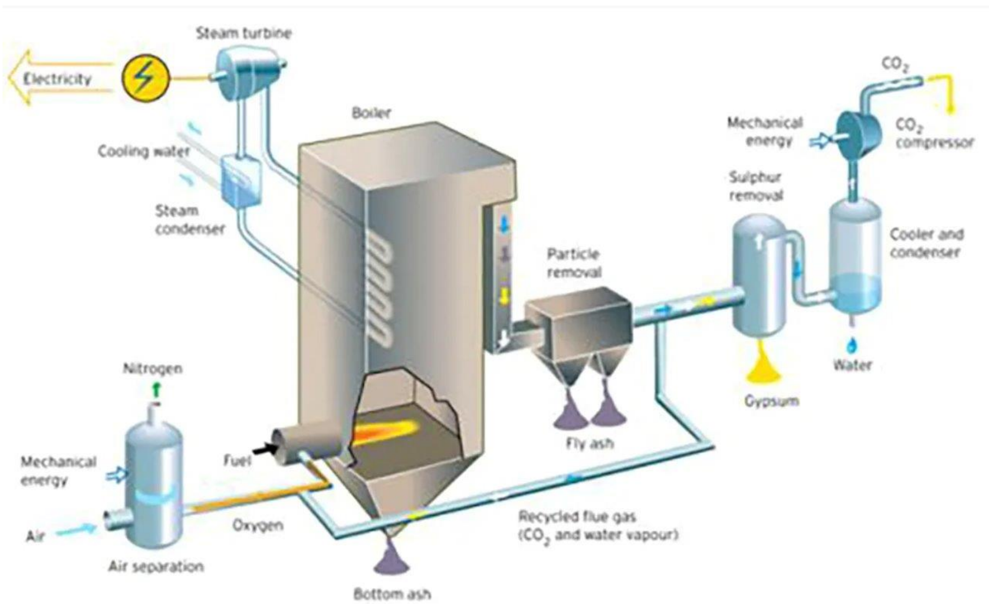
Although chemical looping provides a solution to the increased energy requirements of the ASU and the environmental benefit of hydrogen production within the unit, the process is still in the stages of Technology Readiness Levels (TRL) due to potential risk of metal abrasion. The movement and overlapping of the metal oxide sorbent could affect the process of the carbon capture and prevent the material from looping.

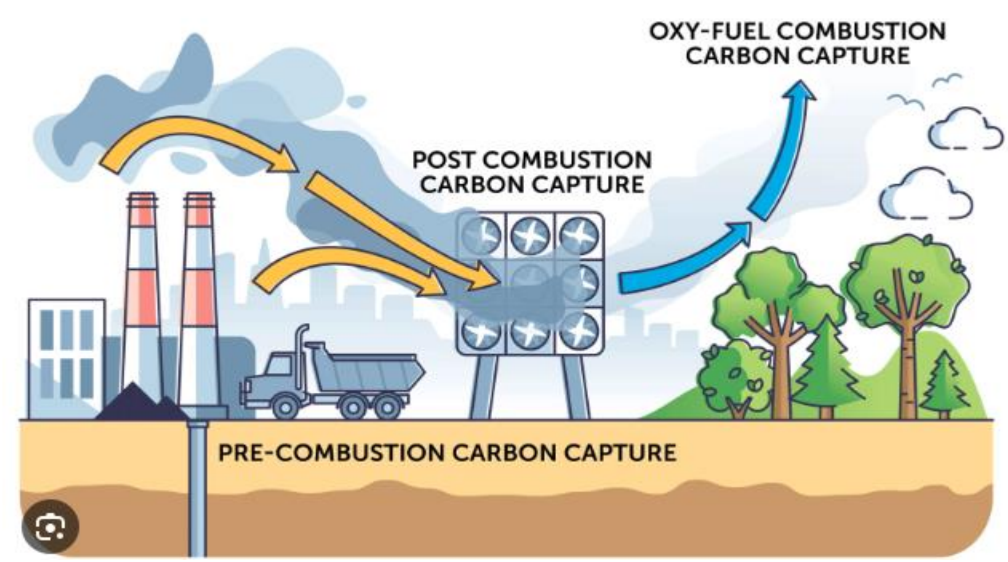
Sources; [69]

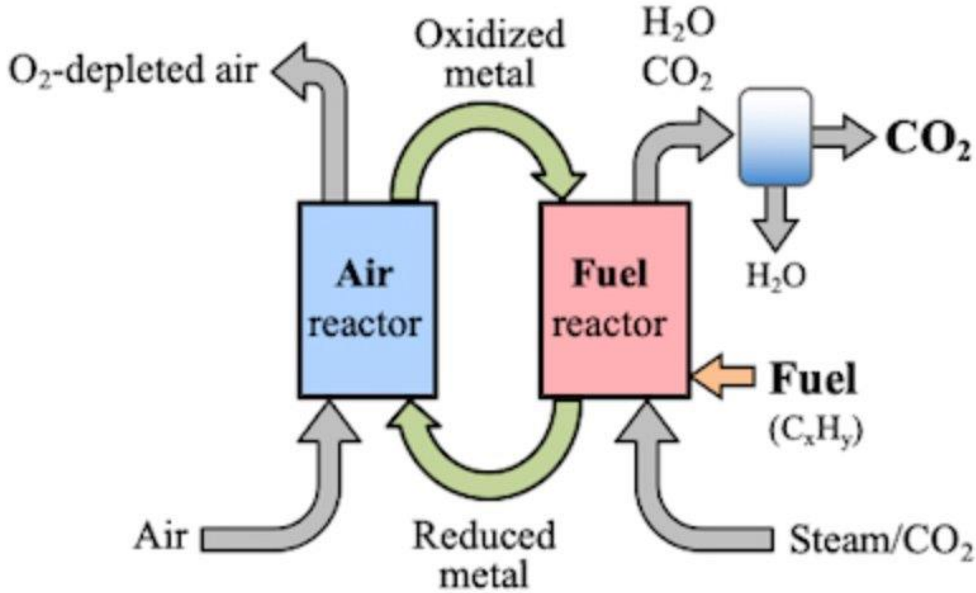
Feb. 4 – Today I found diagrams and images that represent my research in a more visual way. The diagrams that I have chosen to incorporate in my project are:



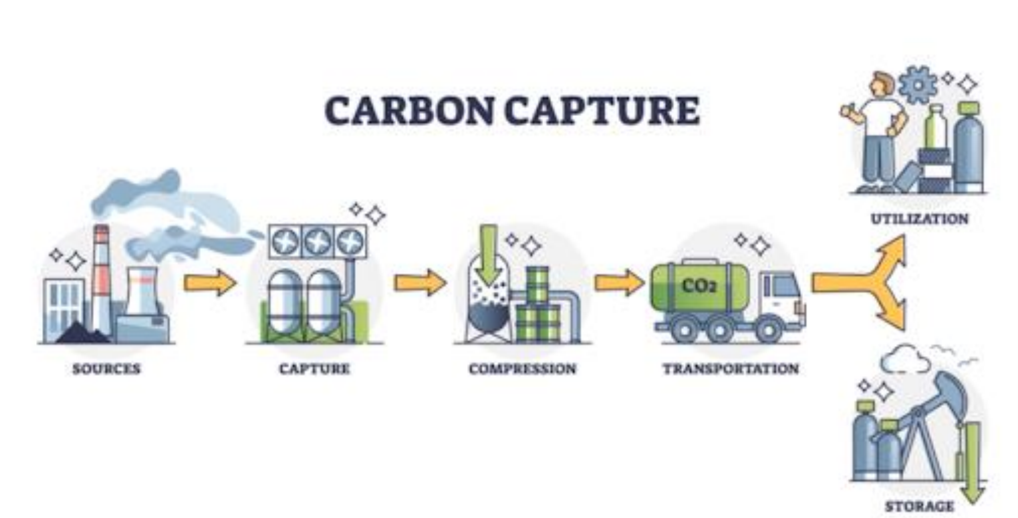



Steam turbine
Electricity
Boiler
Cooling water
Steam condenser
Particle removal
Mechanical energy
CO_2
CO_2 compressor
Sulphur removal
Cooler and condenser
Water
Gypsum
Nitrogen
Mechanical energy
Fuel
Fly ash
Air
Oxygen
Air separation
Recycled flue gas (CO_2 and water vapour)
Bottom ash

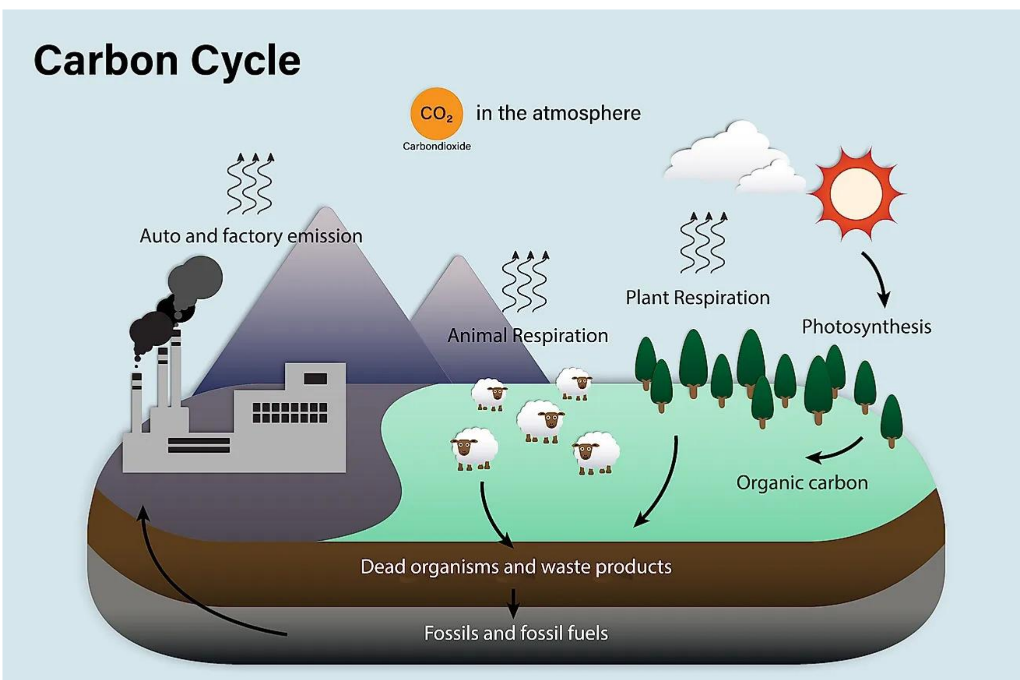

OXY-FUEL COMBUSTION CARBON CAPTURE
POST COMBUSTION CARBON CAPTURE
PRE-COMBUSTION CARBON CAPTURE



O_2-depleted air
Oxidized metal
H_2O
CO_2
CO_2
H_2O
Air reactor
Fuel reactor
Fuel
(C_xH_y)
Air
Reduced metal
Steam/CO_2



CARBON CAPTURE
UTILIZATION
CO_2
SOURCES
CAPTURE
COMPRESSION
TRANSPORTATION
STORAGE



Feb. 5 – Today I defined solubility as a key term. The definition of solubility is:

Solubility is the ability of a solid, liquid, or gaseous chemical substance to dissolve in a solvent and form a solution. For example, sugar usually dissolves in water at 20 degrees Celsius. The simple definition of solubility is the ability to dissolve into another substance. A solute is what is dissolving, and a solvent is the substance that the solute is being dissolved into. When something is insoluble that is because it cannot be dissolved into anything.

Source; [73]

Today, I also picked up my trifold from my science fair coordinator, Ms. Bretner, and brought my trifold home.

I have also answered the question “What can captured carbon dioxide be used for?” from the section “What are Current Carbon Capture Methods?”. The answer to this question is;

Carbon Capture companies are also investing in new technologies to re-use captured carbon dioxide in innovative ways, including jet fuels and automobile seats. Researchers are also exploring ways to convert carbon dioxide into algae biofuels and building materials. McCormick School of Engineering has found a way to convert captured carbon into key industrial chemicals, including ethylene and propanol. Captured carbon dioxide can also be used to make useful products such as fuel, concrete, drinks, urea fertilizer, and so on. Some other materials that can be made from captured carbon dioxide are concrete and plastics. A fuel that can be converted from captured carbon dioxide is biofuel. It is important to utilize he carbon dioxide that we emit rather than storing it. Thus, the development of effective methods of capturing carbon dioxide from various gas streams has become essential.

Sources; [74] and [75]

Feb. 7 – Today I have written out my future spinoff to elaborate on areas of improvement and future thoughts. My future spinoff is: If I were to do another research/study project in science fair in the future, I would add 3D models to fully execute and display the knowledge that I have gained throughout my project. For this project I could have incorporated 3D models by modeling biological, geological, and technological sequestration. Another attribute that I would add to my science fair project in the future is artificial intelligent (AI) graph simulators. This could have enhanced the data for my project, as I could assume the carbon levels in our atmosphere for the future. The AI simulated graphs could have enhanced my date section. For this project, the AI simulated graphs could have added emphasis on how carbon dioxide increases in our project is something we should address. As the simulated graph could have shown how drastic our carbon dioxide level would be on Earth in the future. Other than the two modifications I described above, I would keep my general process for next year.

Feb. 13 – Today I have investigated the benefits of carbon capture to elaborate on my basic knowledge of carbon dioxide: Although carbon dioxide has many negative effects on our environment, there are also positives. Carbon dioxide helps green plants grow faster and more nutritious, as higher carbon dioxide levels allow plants to use water more effectively. Carbon also helps trap heat in our atmosphere. Without it, our planet would be inhospitably cold. When these levels get too high, it can lead to global warming and climate change. Carbon Dioxide also provides energy that fuels our global economy. It is also a key factor in what makes all living life possible. Carbon Dioxide is an essential element in the food chain that sustains us.

Feb. 14 – Today I picked up most of my documents for my trifold.

Feb. 15 - Today I started working on my trifold.

Feb. 16 - Today I continued working on my trifold.

Feb. 17- As of today, I carried on working on my trifold.

Feb. 18 – Today I wrote the conclusion for my project:

In conclusion, there are many ways we can develop carbon capture technologies to benefit future generations. One way that we can develop carbon capture technologies is first to simply ensure that we are considering carbon capture utilization, rather than storage. That way we can utilize and re-use the CO2 emissions that we are releasing into our atmosphere. This will reduce our carbon footprint and will make a difference in Calgary's net zero goal.

Another way we can develop carbon capture is by focusing on technological sequestration. That way we can capture the CO2 straight from the atmosphere, as they is such a high amount of carbon that is already in our atmosphere, so we need to capture that first and then move to extraction methods. Technological sequestration is the most efficient method of carbon capture, because it can be incorporated into different types of carbon combustion and extraction. Technological sequestration is more efficient than geological and biological sequestration as it can be adjusted to capture how ever much carbon is needed at that moment.

Additionally, it is crucial for research to be focused on oxyfuel combustion because within the process of this method of carbon capture combustion you can capture the carbon dioxide, and extract the carbon molecules and release oxygen. This method would not only reduce carbon dioxide levels in our atmosphere but would also increase the oxygen levels. If research by scientists were to be focused on this type of combustion it would be extremely beneficial to our environment.

In conclusion, the technologies that I have briefly discussed above were to be incorporated into one carbon capture plant, the carbon capture technologies in our environment would immensely benefit future generations of Earth.

Developing carbon capture technologies is crucial for mitigating climate change and reducing greenhouse gas emissions. Here are several ways to further advance and enhance carbon capture technologies for future generations:

Research and Development (R&D): Invest in extensive research to understand and improve the efficiency of existing carbon capture technologies and to develop new, more effective methods. This includes exploring novel materials, processes, and technologies.

Cost Reduction: Focus on reducing the costs associated with carbon capture technologies. Lowering the expenses involved in capturing, transporting, and storing captured carbon dioxide will make these technologies more economically viable and scalable.

Scale-up Deployment: Increase the scale of deployment for existing carbon capture technologies to gain more real-world experience and identify potential challenges and opportunities for improvement. This can help refine the technologies and drive down costs through economies of scale.

Incentives and Policy Support: Governments can play a crucial role in promoting the development and adoption of carbon capture technologies by providing financial incentives, tax credits, or other policy mechanisms. These incentives can encourage industries to invest in and adopt carbon capture solutions.

Collaboration and Knowledge Sharing: Encourage collaboration between governments, industries, research institutions, and non-profit organizations. Sharing knowledge and resources can accelerate progress by avoiding duplication of efforts and fostering a collective approach to solving common challenges.

Public Awareness and Acceptance: Raise public awareness about the importance of carbon capture technologies in addressing climate change. Public support can lead to increased funding and political will to invest in these solutions.

Integration with Other Technologies: Explore synergies between carbon capture technologies and other clean energy solutions, such as renewable energy sources and energy storage. Integrating these technologies can create more sustainable and comprehensive approaches to reducing carbon emissions.

Adaptation to Different Sectors: Tailor carbon capture technologies to meet the specific needs of different industries, such as power generation, industrial processes, and transportation. Customized solutions can enhance efficiency and applicability across various sectors.

Monitoring and Verification: Develop robust monitoring and verification systems to ensure the accurate measurement of captured carbon dioxide and its secure storage. This is essential for maintaining transparency and building trust in the effectiveness of carbon capture technologies.

International Collaboration: Climate change is a global challenge that requires international cooperation. Collaborate with other countries to share expertise, resources, and solutions, fostering a collective effort to combat climate change.

By combining these strategies, it is possible to accelerate the development and deployment of carbon capture technologies, contributing to a more sustainable and low-carbon future.

In conclusion, this carbon capture project represents a crucial and innovative step towards addressing the global challenge of climate change. The project embodies a multifaceted approach, combining advancements in both physical extraction from ambient air and geological sequestration from concentrated industrial sources. By harnessing these technologies, we have embarked on a journey to mitigate the impact of anthropogenic carbon dioxide emissions, paving the way for a more sustainable and resilient future.

The significance of this carbon capture initiative lies not only in its potential to significantly reduce greenhouse gas emissions but also in its adaptability to diverse sources, ranging from diffuse emissions to large-scale industrial processes. As we continue to refine and expand these technologies, collaboration between governments, industries, and research institutions becomes paramount. This collective effort is essential to accelerate the development, deployment, and integration of carbon capture solutions across various sectors.

Moreover, the success of the carbon capture project extends beyond technological advancements. It necessitates public awareness, acceptance, and support, reinforcing the importance of transparent communication and education on the project's benefits. Building a global consensus and fostering international collaboration are critical components to tackle climate change on a scale that matches its magnitude.

As we move forward, the lessons learned from this carbon capture project can serve as a blueprint for future initiatives aimed at creating a low-carbon economy. The ongoing commitment to research and development, continuous improvement in cost-effectiveness, and the establishment of supportive policies will be key factors in ensuring the long-term success of carbon capture technologies.

In essence, this carbon capture project marks a pivotal milestone in our journey towards a sustainable and climate-resilient world. It underscores the collective responsibility to innovate, implement, and adapt in the face of climate challenges, offering a glimpse of hope for future generations and a testament to our commitment to safeguarding the health of our planet.

Feb. 20 – Today I had a science fair meeting. We discussed the process for our school science fair. I also printed the remaining documents that I needed for my trifold. Lastly, I added the last few documents to my trifold and completely completed my trifold and presentation.

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