STAO Inquiry Resource Writing Project

Title: Reducing the amount of CO_2 in the atmosphere

Grade Level/Course Code: Grade 10 Academic/Applied Science, SND 2D/2P

Strand(s) and Unit(s): Earth and Space Science: Climate Change (SNC 2D) and Earth and Space Science: Earth's Dynamic Climate (SNC 2P)

Overview: This student-centered inquiry consists of 2 parts to help make the concepts in climate change relevant and applicable to the student's lives. The first part is an inquiry using the scientific method into one aspect of climate change. The students are tasked with "proving" climate change is real using a selected inquiry question. For Part 2, once all students have shared their findings, they are then tasked with a more project-based learning approach. They will use the engineering design process (also known as design thinking) to create something that answers their question regarding climate change.

Inquiry Focus: As a student in _____ high school, how might we have an impact on our community and reduce the effects of climate change by reducing the levels of CO_2 in the atmosphere?
Key words: CO_2, impact, reduce

Timeline: 2 weeks (10 classes), 75 mins/class

Big Ideas:
Climate change affects living things and natural systems in a variety of ways.
People have the responsibility to assess their impact on climate change and to identify effective courses of action to reduce this impact.

Overall Expectations:
A1. demonstrate scientific investigation skills (related to both inquiry and research) in the four areas of skills (initiating and planning, performing and recording, analysing and interpreting, and communicating);
D1. analyse some of the effects of climate change around the world, and assess the effectiveness of initiatives that attempt to address the issue of climate change;
D2. investigate various natural and human factors that influence Earth's climate and climate change;
D3. demonstrate an understanding of natural and human factors, including the greenhouse effect, that influence Earth's climate and contribute to climate change.

Specific Expectations:
ACADEMIC
D1.2 assess, on the basis of research, the effectiveness of some current individual, regional, national, or international initiatives that address the issue of climate change (e.g., Drive Clean, ENERGY STAR, federal and provincial government rebates for retrofitting older buildings to be more energy efficient, carbon offset programs, community tree-planting programs, municipal recycling programs, Intergovernmental Panel on Climate Change [IPCC]), and propose a further course of action related to one of these initiatives
D2.4 investigate a popular hypothesis on a causeand-effect relationship having to do with climate change
APPLIED

D1.2 analyse ways in which human actions (e.g., burning fossil fuels, implementing tree-planting programs) have increased or decreased the production of greenhouse gases
D2.4 conduct an inquiry to determine how different factors (e.g., an increase in surface temperature, an increase in water temperature) affect global warming and climate change
D2.7 compare different perspectives and/or biases evident in discussions of climate change in scientific and nonscientific media

Key Concepts:
SmarterScience, the scientific method, the design thinking process, engineering design

Prior Skill Sets:
Skills in the Scientific Method (ie; SmarterScience framework) so that students can design their own lab.

Prior Knowledge:
Students should be aware of the greenhouse effect, and that CO_2 emissions are a leading cause of the increasing global temperature.

Materials and Equipment:
Potential Laboratory Materials

- thermometer
- beaker
- ice
- carbon dioxide
- clear pop bottles
- aluminum foil
- thermometer clamps
- flashlights
- stoppers
- balloons
- sand
- graduated cylinder
- construction paper
- salt
- scoopula
- retort stand
- Erlenmeyer flask
- candle
- digital thermometers
- safety goggles
- water
- lamps
- convection chamber
- food coloring
- graph paper
- clamps
- beaker
- copper wire
- alka seltzer

Please note that due to the nature of the engineering design process, students may need materials not on this list.
Also needed: devices for students with access to internet (laptop, chromebooks, ipad, etc...) and projector w/speaker for teacher to play videos.

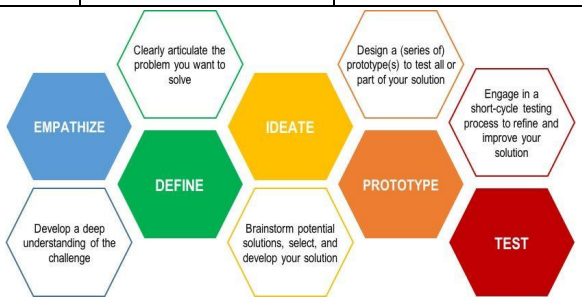
Safety:
Safety guidelines should be the same as for any lab – use PPE if/when needed, no experiment should be conducted without teacher approval and supervision etc.

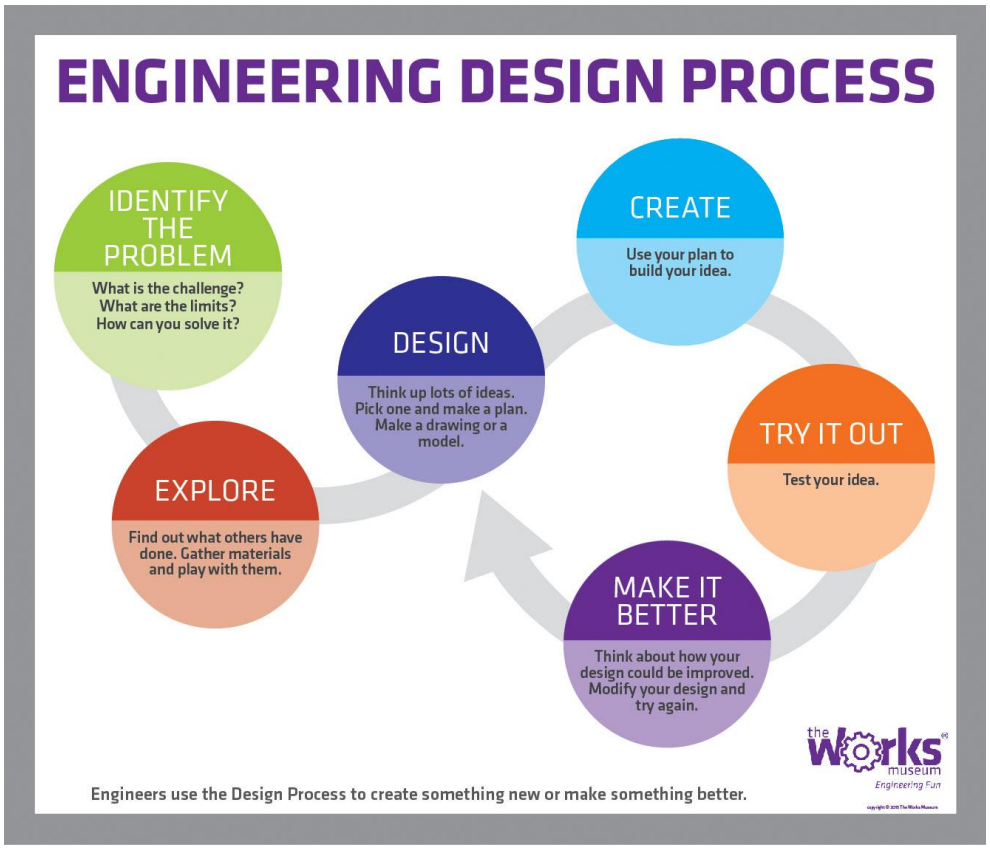
Instructional Planning and Delivery:

Day	Learning Goal	Students will...	Notes
1	I can find evidence that climate change is real	Design a lab to look at the evidence of climate change (Use SmarterScience framework to scaffold the process for 2P or student with LD)	Minds on: Video Action: Choose topic and plan lab (adapted from mrclark.ca) Consolidate: Submit plan to teacher

2	I can find evidence that climate change is real	Perform their lab using SmarterScience framework or editable version	Each group will be examining something different
3	I can find evidence that climate change is real	Discuss their results using Accountable Talk, or present their results to the class.	Minds on: OK strategy or Give 1, Get One strategy Action: Inner/Outer circle using Accountable Talk strategies/prompts Consolidate: use Flipgrid/Exit Card A
4	Identify the problem: Increased CO_2 has contributed directly to climate change. How might we decrease the amount of CO_2 in the atmosphere	Examine Video and Article: Concrete that absorbs CO_2 Explore what others have done	Minds on: Read Article/Video (for empathy) Action: Brain dump/provocation of INQUIRY: "How might we as students in "X" high school decrease the amount of CO_2 in the atmosphere?" This could be done as a class on padlet, or chartpaper. Consolidate: Exit Card B
5	Design/Define	Use the Engineering Design Process to begin to define their idea.	Minds on: Engineering Design Process, Read Rosie Revere Engineer Action: Worksheet for Design Process, Fill in Template using Rosie's cheese hat as an example. (NOTE: Some classes love reading children's books and feeling like they're in elementary school again. If you don't think your class will benefit from this, you can find another example of an engineering design such as UBER, stainless steel straws etc...) Now use one idea from yesterday's braindump to develop a solution to your inquiry question. Consolidate: What would happen if...
6	Create/Prototype	Continue work from day before, Design a prototype that would answer your inquiry question.	Continue work from day before Design a prototype that would answer your inquiry question.
7	Create/Test	Test Prototype and document successes and failures using the Design thinking template. (one copy of the slide deck for each student/group) Students should be adding to this slide deck throughout the design process.	Test Prototype and document successes and failures.
8	Create/Test	Adapt prototype: How could you alter _____ to improve _____?	

9	Make it better	Test Prototype and document successes and failures. Prepare your presentation.	
10	Class Symposium	Present findings to class “Celebrate failure”	Can be done as formal presentations, as a jigsaw, or as a science fair.





Related Background Resources and/or Links:
Here is a list of common misconceptions to watch out for:
https://www.forbes.com/sites/marshallshepherd/2017/03/24/20-common-myths-that-climate-scientists-often-hear/#2303fd2c5acb

WEB LINKS -

1 - Climate Data - A great place to start when looking for a variety of climate data sets.
http://www.ncdc.noaa.gov/paleo/globalwarming/paleolast.html

https://climate.nasa.gov/ - Nasa Quick read stats on current climate variables.

https://climate.nasa.gov/interactives/climate-time-machine - Bioclimatic Profile of the globe showing temperature differentials against century based average

2 - IPCC Publications Page - These folks have already sorted through which publications are relevant and what they all mean. Start here to find WHO is actually doing this research.
http://www.ipcc.ch/publications_and_data/publications_and_data_reports.htm

3 - Canada Center for Remote Sensing - lots of data and information on climate, ice coverage etc. Basically anything that can be observed about the surface of the Earth from space.
http://ccrs.nrcan.gc.ca/

4 - Environment Canada - a host of web pages on various weather and climate topics

5 - Physics.org - a repository of new studies about climate and climate change. Mostly well cited and peer-reviewed studies.
6 - Lindsay & Emily's Blog - How are trees responsible for increased CO_2 increases?
www.deforestationgenious.blogspot.com

ANIMATIONS AND WEB LINKS

Greenhouse Effect Demonstration **-**
http://phet.colorado.edu/simulations/sims.php?sim=The_Greenhouse_Effect

Carbon Cycle Interactive Diagram - See how sources and sinks of carbon move this element through its cycle.

VIDEOS

BIOCLIMATIC PROFILE - see this NASA animation of how climate change has driven changes in vegetation for the past 20 years.
Ancient Weather - Killer Climate - Looking at Catastrophic climate changes in Earth's History

Coriolis Effect and Hurricanes - Neil DeGrasse Tyson discusses how Hurricanes form and the role of the Coriolis effect in determining the direction of airflow!

National Geographic Videos - a collection of free videos on various topics

NY Times on IPCC 2013 report - preview of the 5TH IPCC report

Assessment Opportunities:
Link to Rubric for the inqury and more detailed rubric here
Link to Rubric for Design Thinking Process

Future Opportunities / Extensions:
Depending on the projects developed, this could lead to multiple things – a better recycling program, fundraisers, climate change awareness campaigns. The possibilities are endless!