Category	Life Sciences
Theme	Environmental Awareness
Unit 2 Title	Dealing with Climate Change
Unit Essential Question	How can we reduce the impact of climate change?
Grade Level	Grade (6-8)

Unit Overview

The problem:
July, 2019 was recorded as the warmest month in history. In general, it is anticipated that the period between 2015 to 2019 is turning out to be the hottest years in history (World Meteorological Organization, 2019). In Egypt, we continuously feel the summer heatwaves. As there is no hint for any environmental improvement, the climate change problem will continue bringing us more heatwaves and warmer weathers in the years to come. While using air conditioners might look like an immediate solution that helps us deal with the problem, the power used by air conditioners, like most other regular electricity-run devices, actually add to the problem causing climate change. Do you know why? Can you help us have a better solution that might have less negative impact on the environment?

Reference: https://public.wmo.int/en/media/news/july-matched-and-maybe-broke-record-hottest-month-analysis-began

The design challenge for this unit is:
Creating an eco-friendly tool/ device that helps people deal with hot weather OR improve the performance of the existing devices so that it consumes less energy and be eco friendly, too.

Established Goals

Transfer goals:
This unit is expected to help students understand the problem of global warming. It also aims to support them identify ways and solutions and take action to help slow down the effects of climate change. Students will use digital tools to be able to express their ideas and solutions in a persuasive way.

By the end of this unit students will:

Knowledge and understanding:

Based on the national matrix (text books)

- Describe the global warming phenomenon and the greenhouse effect. (2ndprep, t1, science book, p. 61)
- Identify greenhouse gases. (2ndprep, t1, science book, p. 61)
- Explain the concept of climate change (https://www.teachengineering.org/lessons/view/cub_weather_lesson06
- Interpret the rising temperature of the earth's atmosphere. (2ndprep, t1, science book, p. 61)
- Determine the negative effects resulted from the rising temperature of the earth's atmosphere. (2ndprep, t1, science book, p. 61)
- Explain the scientific evidence behind climate change.

Skills:

- Identify ways that could help slow down global warming. (http://sensor.nevada.edu/Static/Documents/Education/Washoe%20Activities/Reference/EPSCoR%20GCC%20Activity%20Manual.rev6-17.pdf)
- Interpret visual data to better understand the climate change phenomenon.
- Represent and analyze numerical data to better understand the climate change phenomenon.

Values and attitudes:

- Recognize how their personal choices could impact the environment.
- Develop an attitude towards (managing) energy consumption.
- Recognize ways that helps lower their carbon footprint.
- Realize the rights of the future generations in ..
- Take actions to support minimizing the impact of climate change.
- Work with people at the school/ and local community to support better decisions for ..
- "Assess personal carbon emissions" (source: https://www.nps.gov/glac/learn/education/upload/Climate_change_MS-

Unit_Final.pdf)

Standards Correlation		
Next Generation Science Standards (NGSS)	**Common Core State Standards (CCSS Math)**	**Common Core State Standards (CCSS Literacy)**
MS-ESS3-5 **Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century** **MS-ETS1 Engineering Design** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.	CCSS.MATH.CONTENT.6.SP.A.2 Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape. CCSS.MATH.CONTENT.6.SP.A.3 Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number CCSS.MATH.CONTENT.6.SP.B.5.C Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the	Key Ideas and Details: CCSS.ELA-LITERACY.RI.6.1/ CCSS.ELA-LITERACY.RI.8.1 Cite textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text. CCSS.ELA-LITERACY.RI.6.2 Determine a central idea of a text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments. Craft and Structure: CCSS.ELA-LITERACY.RI.6.4 Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings.

MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. _____ MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.	overall pattern with reference to the context in which the data were gathered CCSS.MATH.CONTENT.6.SP.B.4 Display numerical data in plots on a number line, including dot plots, histograms, and box plots CCS.5.G.3.Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category. *For example, all rectangles have four right angles and squares are rectangles, so all squares have four right angles.* CCS.5.G.4.Classify two-dimensional figures in a hierarchy based on properties. CCS.6.NS.5.Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.	CCSS.ELA-LITERACY.RI.7.5 Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to the development of the ideas. CCSS.ELA-LITERACY.RI.6.6 Determine an author's point of view or purpose in a text and explain how it is conveyed in the text Writing: Text Types and Purposes: CCSS.ELA-LITERACY.W.6.1 Write arguments to support claims with clear reasons and relevant evidence CCSS.ELA-LITERACY.W.6.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content CCSS.ELA-LITERACY.W.6.2 Write informative/explanatory texts to

		examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content CCSS.ELA-LITERACY.W.6.8 Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. CCSS.ELA-LITERACY.W.6.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.
National Standards (Maths & Science)	**National Standards (Social studies & Literacy)**	**Digital Literacy Standards (Massachusetts Curriculum Framework)** http://www.doe.mass.edu/frameworks/dlcs.pdf
Science (Prep. 2) - يصف ظاهرة الاحتباس الحراري وآثارها على الأرض	Geography (Prep. 1): - يحلل البيانات من المنظور الجغرافي مستخدما	**Safety and Security [6-8.CAS.a]** 4.Describe and use safe, appropriate, and

responsible practices (netiquette) when participating in online communities (e.g., discussion groups, blogs, social networking sites). 5. Differentiate between appropriate and inappropriate content on the Internet. **Ethics and Laws [6-8.CAS.b]** 1. Explain how copyright law and licensing protect the owner of intellectual property. 3. Apply fair use for using copyrighted materials (e.g., images, music, video, text). **Interpersonal and Societal Impact [6-8.CAS.c]** Evaluate how media and technology can be used to distort, exaggerate, and misrepresent information. 5. Evaluate the bias of digital information sources, including websites.	الأدوات الجغرافية المختلفة (مثل: الخرائط, الرسوم البيانية, النماذج, الصور, والكرات الأرضية). - يستخدم الخرائط والنماذج والمجسمات لتوضيح التوزيعات المكانية على سطح الأرض مثل: توزيع القارات, والمحيطات, والأقاليم النباتية, والأقاليم المناخية. - يستخدم شبكة المعلومات الدولية (الإنترنت) في جمع معلومات مصورة عن (المجموعة الشمسية, والأقاليم المناخية, والأقاليم النباتية). - المجال الثالث: البيئة المجتمع المعيار الأول: توضيح العلاقة المتبادلة بين البيئة الطبيعية والبيئة البشرية - يعطي تعريفا لكل من (البيئة - النظام البيئي - التوازن البيئي - مجموعة شمسية - مجرة - كوكب - نجم - تسونامي ..) - يوضح تأثير الإنسان في البيئة الطبيعية. Geography (Prep. 2) - يبحث مشكلة بيئية معاصرة في وطنه العربي مستخدما تكنولوجيا المعلومات وأثرها على الإنسان - يستنتج تأثير بعض الأنشطة الاقتصادية على البيئة بالوطن العربي - يضع خطة للتنمية المستدامة للموارد الاقتصادية بالوطن العربي History (Prep. 3). - يحلل تأثير التطور العلمي على تنوع الأنشطة	- يفسر ارتفاع درجة حرارة الغلاف الجوي للأرض - يحدد الآثار السلبية المترتبة على ارتفاع درجة حرارة الغلاف الجوي للأرض. - يقترح حلولا لمشكلة الاحتباس الحراري Science (Prep. 3). - يفهم البيئة ومكوناتها وكيفية المحافظة عليها - يوضح مفهوم المنظومة البيئية - يتعرف بعض المنظومات البيئية - يشرح أهمية حماية البيئة الطبيعية Maths (prep. 1). - يرسم المنحنى المتجمع الصاعد والمنحنى المتجمع النازل لبيانات في جداول ذات مجموعات - يقرأ ويفسر جداول وأشكال بيانية Maths (prep. 2). - يوجد الوسط الحسابي لمجموعة من القيم - يوجد الوسط الحسابي لبيانات في جداول تكرارية ذات مجموعات - يوجد الوسيط والمنوال لبيانات في جداول تكرارية ذان مجموعات بيانياً - يكون جدول تكراري متجمع نازل لمجموعة من البيانات - الأول والثاني الإعدادي:

	البشرية عبر العصر الحديث والمعاصر	- يستخدم النمذجة الهندسية في مواقف حياتية عملية ومواد دراسية أخرى - يصمم مخططات بسيطة لمنشآت باستخدام أشكال هندسية مناسبة في صورة أنشطة

Integrated Concepts		
Science	**Engineering & Technology**	**Maths**
● Plant nutrition (Photosynthesis) ● Air pollution ● Water pollution ● Global warming/ climate change ● Greenhouse effect ● Greenhouse gases ● The carbon cycle ● Carbon footprint ● Renewable and nonrenewable sources of energy	Impact of the engineering designs on the climate. Efficient use of energy	● Representing and interpreting data ● Average, median and mean
Literacy/ Language Arts	**Social Studies**	**Citizenship**
● Persuasive writing ● Language used to describe the climate. /vocabulary related to climate change ● Figurative speech	● The historical causes of climate change ● The industrial revolution ● Weather, climate & atmosphere ●	● Environmental awareness ● Rational power consumption/ saving energy
Digital Literacy	**Other**	**Other**

Copyrighted images Evaluating digital information		

Learning Plan Overview			
Lesson	**Lesson Questions**	**Learning Objectives**	**Assessment Evidence**
Phase 1 Identify the problem/need	What do we know about climate change? What evidence indicates that there is a problem? How do we know that the climate is changing? Why should we worry about climate change?	1. "Develop a climate change learning wall" (Creating Futures Unit) 2. Interpret visual evidence and evaluate image credibility. 3. Interpret graphs and numerical data	
Design challenge milestone 1	What are we designing? And why?	1. Identify the need for a specific engineering design project 2. Describe the design project context. Identify and differentiate the design project constraints and requirements. https://www.teachengineering.org/activities/view/cub_creative_activity1	
Phase 2 Research/ Learn the basics	What is the difference between weather and climate? What is global warming? What causes global warming? ("why	1. Differentiate between weather and climate 2. Describe the global warming phenomenon and the greenhouse	

	is earth's climate changing" trocare.org) What is the greenhouse effect? What are the greenhouse gasses? What produces greenhouse emissions? What are the effects of global warming? (or how does global warming impacts our planet?) What are the consequences of climate changes on people, plants and the planet? What is the carbon cycle?	effect. (Prep2, T1, p. 61). 3. Identify greenhouse gases. 3. Interpret the rising temperature of the earth's atmosphere. (Prep2, T1, p. 61). 4. Determine the negative effects resulted from the rising temperature of the earth's atmosphere. (Prep2, T1, p. 61).	
Engineering Design Milestone 2	What new things did we learn about the design problem? Do we need to change anything with our design overall goals?	Revisit initial design questions. Conduct further research on the design problem as needed. Reflect on knowledge and skills acquired during phase 2. Connect acquired knowledge and skills to the design challenge.	
Phase 3 Explore possible solutions	How may we reduce the greenhouse effect/ the impact of climate changes? What alternatives are there for using carbon(..) energy sources?	Differentiate between renewable and nonrenewable energy Research existing solutions to the unit's problem.	
Engineering Design Milestone 3	What are the available solutions to the problem? Which solutions are more effective?	Research existing solutions to the unit's problem.	

	How can we make use of the available solutions in creating our design?	Evaluate existing solutions by identifying their strengths and weaknesses. Decide on ideas or technologies that could inspire the design solution.	
Phase 4 Plan for action **Engineering Design Milestone 4**	How would our design look like? What's the idea behind it? How much would it cost? How can we improve our plan? What materials will be needed?	Draw an outline of the design Anticipate possible constraints of the design Estimate expected design costs. Exchange feedback with other design teams	
Phase 5 Build, test & redesign **Engineering Design Milestone 5**	Would our design meet the required specifications? What can we do to improve our design?	1. Create an initial (prototype) version of the design. 2. Evaluate design functions with regards to specifications. 3. Redesign to solve problems in initial design and make the necessary modifications.	
Phase 6 Communicate & reflect **Engineering Design Milestone 6**	How can we present our solution? How do we evaluate the entire design process? How do we feel about the entire process? To what extent are we satisfied with our participation within the design teams? How was our final product different from the initial design? What helped us decide on the final solution?	1. Present the final designs and describe the process. 2. Communicate with other teams to get feedback. 3. Reflect on the full design process.	

	What did we learn from the process? What do we need to consider for future designs?		

Phase 1 **Identify the Problem or Need** In Egypt, we continuously feel the summer heatwaves. As there is no hint for any environmental improvement, the climate change problem will continue bringing us more heatwaves and warmer weathers in the years to come. While using air conditioners might look like an immediate solution that helps us deal with the problem, the power used by air conditioners, like most other regular electricity-run devices, actually add to the problem causing climate change. Do you know why? Can you help us have a better solution that might have less negative impact on the environment?		
Activity 1: Climate Change Learning Tree		
Activity Duration: Initial activity duration: (15 - 25 minutes). Can be continued in shorter time allocation throughout the unit.	**Activity type:** Whole-class activity	**Resources:** **Activity is mainly incorporated from:** https://www.trocaire.org/sites/default/files/resources/edu/creating-futures-full.pdf
Activity objectives: ● Demonstrate prior knowledge of the topic. ● Raise questions about climate change. ● Develop curiosity to further explore the climate change topic. ● Classify & categorize related statements and/or questions.		

Materials needed:

Printed (or canson cutout) leaves and drops
Markers
Tack or light tape to fix the leaves and drops on the wall
A full canson size tree branches layout (brown)

Procedures:

- Before class: The teacher prints off or cuts out leaves and drops shaped papers. (Each shape is at least equal to the number of the students in class) (Provide more copies when possible)
- The teacher selects an empty space on one of the class walls, and tells the students that they are going to use this wall to display their learning progress throughout this unit.
- The teacher introduces the unit's problem and writes it on the board.
- Each student initially receives at least one leaf.. The teacher explains that they will use the leaves to write about what they already know about the topic.
- The teacher points to a label that says "What do we already know?" (printed or handwritten)
- The teacher continues by asking leading questions:
  (possible guiding questions: Have you ever heard about "Climate Change"? - Do you know anything about it? How do you think it affects people and living creatures?
- The teacher models what the students are expected to do by two things: 1. The teacher writes on the board " I know that .." and tells the student that they will follow this structure while writing on their leaves. 2. The teacher takes a leaf and write one thing he/she knows about climate change. (for example: I know that the weather on earth has been extremely changing)
- Students are asked to follow the pattern and stick their leaves to the wall.
- After all students add their leaves, the students could take turns reading what their peers wrote.
- The teacher (or a few students) could be asked to read what was written on the leaves, and with a group discussion, they get to group similar questions together.
- With the teacher's guidance, students suggest main ideas for each group of questions. (each related leaves could be placed on one branch for example)

How the learning tree could look like after adding the leaves		Image source: https://jenniferbrokofsky.files.wordpress.com/2011/06/rainforest_learning_tree_21.jpg

- Same process gets repeated with “things we want to know the label”.
- Students are asked to write questions they have about the topic on the cut out drops.
- That teacher concludes that activity by mentioning that throughout this unit, the class will explore the raised questions to get a deeper understanding of climate change.
- Throughout the unit, students can have access to extra “water drops” cut off, to keep adding questions.
- Throughout the unit, the class can revisit the learning wall to comment on how they initially began exploring the topic.
- The teacher can refer to the questions written on the drops when he/she deals with activities relevant to them. The class can continuously discuss (weather some questions could be answered, and whether new questions can be added)
- “Apples” cut offs can also be used to add “what the students learned” to their climate change learning tree.

Activity 2: Visualizing Climate Change		
Activity duration: 40-45 minutes	**Activity type:** Whole class & pair work	**Resources:** https://curriculum.climategen.org/2017/NGC/NGC2017-1-3-Temperature-Indicators-Figure-Set.pdf

		https://climate.nasa.gov/images-of-change?id=376#376-muir-glacier-melt-alaska

Activity objectives:

- Visualize the problem of climate change using images.
- Use image evidence to present the climate change problem.
- Apply fair use for using copyrighted images.

Materials needed:

Computers (school lab)
Internet connection

1941 photo taken by Ulysses William O. Field; 2004 photo taken by Bruce F. Molnia. Courtesy of the Glacier Photograph Collection, National Snow and Ice Data Center/World Data Center for Glaciology. NASA Jet Propulsion Laboratory. (n.d.). Images of Change. Retrieved from https://climate.nasa.gov/images-of-change?id=376#376-muir-glacier-melt-alaska

Procedures:

Stage 1: photo reflection (whole class) (10 minutes)

- The teacher displays the two photos above, and asks the students what do they notice? Can they compare and contrast the two images? Which one was taken first? Why? Can they predict where the water came from?
- Based on the caption under the photos, the teacher asks the students to identify the year each photo was taken.
- They are then asked to reflect and think of what may have happened between the two dates.

- The teacher introduces more questions: Do you think the comparison is valid? What if the two photos were taken at two different seasons? Do you think this would still support the idea the climate is changing? What if the two photos were taken in two different locations?

Stage 2: search original sources (pair work) (15 minutes)

- The students get into pairs.
- The students are asked to use the computers to search for the original data of the two photos.
- They are given only 10 minutes to: (1) make sure the names of the photographers are accurate, (2) identify the date each photo was taken (including the month/ season), and (3) verify the location each photo was taken.
- After the students complete their search, the teacher can use the following link to conclude the reflective activity: https://climate.nasa.gov/images-of-change?id=376#376-muir-glacier-melt-alaska
- In the last 5 minutes of this stage, the teacher and students comment on what makes these two photos a valid representation of the climate change problem.

Stage 3: photo collection (pair work) (15 minutes)

- The teacher tells the students they are going to search for more photos to create a collection of visual evidence of climate change.
- Each pair is asked to: (1) find two photos of the same place that could be used as an evidence of climate change, (2) record: names of the photographers, dates the photos were taken, URL(s) to the images source(s), (3) write a two sentences brief on the location captured in the photos.

Stage 4: collection display (Optional)

- The students can create any of the following out of the collected photos: (1) a poster to place on a school's wall, or (2) a collective blog entry to be accessed online.

Activity 3: Interview an old relative		
Activity duration: 15 minutes (outside the class) 20 minutes (inclass)	**Activity type:** Individual work (home assignment)	**Resources** **https://www.climategen.org/take-action/teach-climate-change/curriculum/next-generation-climate-for-grades-6-8/**

Activity objectives:

- Summarize oral information and paraphrase them into a written text.

Materials needed:

- Sample interview questions (handout or word document)

Procedures:

- In a previous class, the teacher introduces the following task to be done outside the class.
- Students are asked to choose an old relative to interview them about the weather in the past.
- Students should ask their relatives:
    1. How did the weather look like when they were young?
    2. Why do they think the weather has (or hasn't) changed?
    3. Are there any activities that were either easier or more difficult (because of the weather)?
- Students are asked to summarize the main ideas of their interviews and present it to the class the following session.
- At the beginning of the following class, each student gets 3 minutes to share a summary of their findings with the class.
- (possible extension: students can be guided to write a short report on their findings, and add their personal reactions on the responses of their old relatives).

Activity 4: Weather vs climate		
Activity duration: one session / 45 minutes	**Activity type: Whole class or pair work**	**Sources:** ● **Lesson plan** ● **Video 1** ● **Video 2** ● **Weather or climate worksheet (p.33)**

Activity objectives:

- Differentiate between weather and climate by providing specific examples

Materials needed:

- KWL chart (teacher can use the board or a large wall poster)
- Computer, Projector and speakers
- A sheet divided into two columns / or use students notebooks

Procedures:

1. The lesson starts with the teacher eliciting the differences between weather and climate using some guiding questions like:
    a. What does the word climate mean? What does the word weather mean? Are there any differences?
    b. Which of the two is changing frequently? Which is more stable?
    c. Can you give specific examples to show the difference between weather and climate?
2. The teacher asks the students to answer in pairs and fill in the KWL chart with one or two ideas about each of the following:
    a. What they know and what they want to know about the climate
    b. What they know and what they want to know about the weather
    c. What they learned about the two terms (This part will be completed at the end of the activity)
3. Teacher checks if students wrote true information under the K section
4. Teacher gives each student the sheet with two columns, one for weather and one for climate, and asks students to watch three short videos and try to fill each column with facts about both weather and climate. Students can use their notebooks instead of the sheets.
5. The teacher pauses after each video, and asks students to share some of the information they heard from the video about the weather and the climate.
6. After completing the videos and discussions, the exit activity can be a number of statements that students identify either as climate or weather. Their responses will reflect their understanding of the main differences. Some statements can be:
    a. Egypt is usually sunny (Climate or weather)
    b. It changes from day to day (Climate or weather)
    c. It can be stable for a long time (Climate or weather)
    d. It is the typical or common condition for a specific area (Climate or weather)
    e. It is stormy today; however, yesterday was sunny. (Climate or weather)
    f. Every year, we encounter warm Winter and hot Summer (Climate or weather)
    g. Egypt is usually struck by sand storms in Spring (Climate or weather)
    h. Aswan is a well-known spot for vacations in Winter because of its warm temperature. (Climate or weather)

    A similar activity can be the following:

a. Teacher divides students into small groups. Each group is asked to plan for an event in the school yard. The event should include some activities organized by the students.
b. Students decide the time and the nature of the activity depending on the weather/climate.
c. Teacher discusses the activities planned by each group according to the weather/climate during the time frame of the event
d. Teacher then shares a worksheet (p.33) and asks students to sort the comments as either weather or climate.

Activity 5: Global Temperature Indicators		
Activity duration: 35 MINUTES	**Activity type:** **Whole class & pair work**	**Resources** **https://www.climategen.org/take-action/teach-climate-change/curriculum/next-generation-climate-for-grades-6-8/**

Activity objectives:

- Interpret data from a graph.

Materials needed:

- Global temperature anomaly (1st page in: https://curriculum.climategen.org/2017/NGC/NGC2017-1-1-GlobalLandandOceanTempAnomaliesGraphs.pdf
- Temperature indicators worksheet: https://curriculum.climategen.org/2017/NGC/NGC2017-1-2-Lesson-1-Worksheet-Temperature-Indicators.pdf

Procedures:

1. The teacher displays the global temperature anomaly or print it out for students when a data show is not available.
2. In pairs, students discuss the following questions (15 minutes)
3. As a whole class discussion, the teacher and students go through the pair answers. (10 minutes)
4. Students then get the chance to comment on their observation of the figure, and reflect on how the graph helped/ or didn't help them visualize the problem in hand (10 minutes)

Questions source: Temperature indicators worksheet:
https://curriculum.climategen.org/2017/NGC/NGC2017-1-2-Lesson-1-Worksheet-Temperature-Indicators.pdf

1. What is the first thing that you notice about this figure?
2. What is one thing about this figure that you find interesting?
3. What questions do you have about this figure? Write them down. Think of at least 3.
4. Does this figure represent climate data or weather data? Explain.
5. Write one sentence about what this figure is saying (include specific data from figure).
6. What does the information tell you about global temperatures?
7. How did scientists collect this data? (scientific instruments, scientist's eyes, citizen's eyes, traveling, other)
8. What organization or person collected the information?
9. When was the data collected?
10. Write down a question that you would ask the creator of the figure or the researcher behind the information?
11. Is this reliable (able to be trusted) data? Why or why not?

Activity 6: Egypt's Temperature Indicators		
Activity duration: 20 minutes	**Activity type:** **Individual work followed by pair or whole class discussion**	**Resources:**

Activity objectives:

- Calculate the average temperature of a 5 years range.
- Represent data on a graph.
-

Materials needed:

- Graph sheets
- Activity printout

Procedures:

- **The teacher prints the following questions and hand each student a copy. Students are given 15 minutes to complete this task individually. The teacher moves around to monitor the students and provides them with guiding questions.**

The below table indicates the annual average temperatures in Egypt in the past 30 years** (in degrees celsius).

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Average maximum temperature **	27.5	27.5	27.2	26.4	27.2	27.4	27.1	28.6	27.2	27.1	28.1	27.5	28.2	28	28.1
5 years average	..... (A: 27.16)					..... (A: 27.48)					..... (A: 27.98)				
Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Average maximum temperature **	28.1	27.9	28	28.3	28.7	28.6	29.7	27.5	27.9	27.9	28.1	27.8	29.1	28.4	29.1
5 years average	..... (A: 28.2)					..... (A: 28.32)					..... (A: 28.5)				

** Temperature data source:
https://www.weatheronline.co.uk/weather/maps/city?LANG=en&PLZ=____&PLZN=____&WMO=62366&CONT=afri&R=0&LEVEL=162&REGION=0011&LAND=EG&MOD=tab&ART=TEM&NOREGION=0&FMM=1&FYY=2000&LMM=12&LYY=2001

1. Calculate the average temperature of each 5 years range and write them to complete the table.
2. Which years range has the lowest average? ……..
3. Which years range has the highest average? ……..
4. What do the numbers you calculated indicate?
   ……..
5. Calculate the percent increase/decrease between the average temperature of (1989/1993) and (2014/2018)
   ……..
6. Use your graph sheets to draw a figure representing the climate trends of the past 30 years pointing the 5 years averages you calculated.

- **After completing the individual task, students pair to check and discuss and check their answers. The teacher ends the activity with a short whole class discussion.**
- **The teacher discusses with the students how the calculating the averages of longer time periods (even longer than 5 years) could help us understand the long-term trends. The teacher highlights that looking at a single year or a few years indicators might not be the best way to help us understand the phenomenon.**

Engineering Design Milestone		
Duration: 40-50 minutes	**Activity type: (Group Work/ Design teams)**	**Resources** **Questions adapted from:** **https://www.teachengineering.org/content/cub_/activities/cub_creative/cub_creative_activity1_worksheet_v3_tedl_dwc.pdf**
Objectives: 1. Define the design challenge 2. Summarize the problem/need the design attempts to 3. Identify the need for a specific engineering design project. 4. Describe the design project context. 5. Identify and differentiate the design project constraints and requirements. https://www.teachengineering.org/activities/view/cub_creative_activity1		
Procedures: - The teacher divides the students into the design teams (4-6 students each).The teacher introduces the design mission as follows:		

The design challenge

1. Design a tool/ device to help people deal with heat waves.
2. Design specifications

1- Use renewable energy source to run the tool/device.

3. Your design must be design cost-effective. Your prototype should not exceed ….L.E.

Improve the design to meet the specifications.

4- Your design should be able to lower the temperature (range 1-2) in a meter space around it

- In their design groups, students will start working on the following graphic organizer.
- Throughout the activity, the teacher needs to move around, and provide the teams with comments and questions to help the student focus their ideas.
- After filling the graphic organizer, the students can start creating posters on flipcharts to present their ideas.

Why are we desiging?

Why do we need this design?

What is the problem/ or need we are trying to solve? In general, who are the people affected with this problem?

How do we plan for the design?

In what way do we need our design to be different/ unique from similar solutions?

What do we need to know to help us start with the design process?

What are we desiging?

What do we need to design?

What are the design requirements?

What are the design constraints?

(What is the purpose of our design?

Where could our design be used?

In what context do we want it to be used?

Who can use it?

Who are the target audience of our design? Who are we designing for?

Phase 2
Research the Problem/ Learn the Basics

Activity 1: The carbon cycle

Activity duration:	**Activity type:**	**Resources & videos** https://ed.ted.com/lessons/the-carbon-cycle-nathaniel-manning#watch https://betterlesson.com/lesson/639915/exploring-the-carbon-cycle https://www.teachengineering.org/lessons/view/cub_carbon_lesson01

Activity objectives:

- Analyze the carbon cycle in the ecosystem for both the living and nonliving

Materials needed:

- Computer and projector
- Carbon dioxide cycle picture/ printout

Procedures:

1. Warm-up activity: Ask the students to fill out the following table:

Statements	**True or false**	**If true, give an example** **If false, correct the statement and give an example**
Plants use Carbon dioxide		
Only cars produce Carbon dioxide		

Humans cannot add carbon dioxide in the atmosphere		

2. Teachers can add other statements to the table above to check some of the misconceptions.
3. After discussing the statements in the table, give the students a sheet with some multiple choice questions about the video that you will play in class. Ask them to read the questions and the choices before you play the video.
4. Play the TED ED video about the carbon cycle and ask the students to answer while listening. If required, the video can be played twice.
5. After the video, review the answers with the students and engage in a discussion about the video
6. Show the students the picture below:

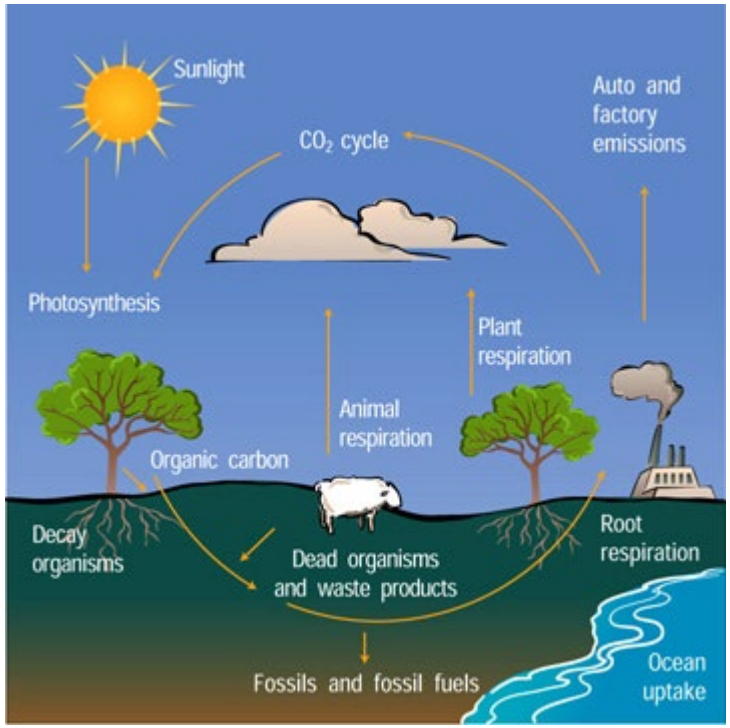

Image source: https://eo.ucar.edu/kids/green/images/carboncycle.jpg

7. Keep the image posted on a wall or on the screen/ board (through a projector) to remind the student of the cycle and refer to it whenever needed.
8. Ask the students to read the article about carbon cycle then discuss it through the following questions:
    a. What role is played by the carbon cycle?
    b. Why is it important?
    c. Provide a description for the main method with which carbon is cycled
    d. How did human activities increase the levels of carbon dioxide in the atmosphere?
9. Based on the article, ask the students to write 4 sentences by combining a term from the following two columns:

Column 1	Column 2
Photosynthesis Atmosphere Sedimentation Cellular respiration	Fossil Byproduct Organic compound Reservoir

10. The sentences should clarify the relationship between the terms
11. Ask students to share their sentences with their peers or with the whole class for discussion
12. Ask the students to re-write inaccurate sentences if needed

Activity 2: Climate change jigsaw reading		
Activity duration: **60 minutes**	**Activity type: group work**	**Resources:** **Video:** https://www.nationalgeographic.com/environment/global-warming/global-warming-overview/ Reading texts references: https://www.teachengineering.org/lessons/vie

		w/cub_weather_lesson06 https://www.teachengineering.org/lessons/view/cub_footprint_lesson1 https://ecology.wa.gov/Air-Climate/Climate-change/Climate-change-the-environment https://www.livescience.com/37003-global-warming.html http://www.takepart.com/flashcards/what-is-a-carbon-footprint/index.html

Activity objectives:

- Describe the causes of global warming.
- Identify the greenhouse gases.

Materials needed:

- Handouts of 4 reading texts
- Markers
- Flipchart
- Guiding questions handout

Procedures:

- The teacher divides the students into 4 “home groups”. Each group includes (4-6 students).
- Each student in the home group gets a copy of a different reading text (overlap can happen if the group included more than 4 students)
- The teacher asks students to read their assigned text silently. (5 minutes).
- The teacher then asks the students who have the same reading texts to form expert groups. (i.e. all students with reading text 1 get into the same group. Same for students with reading texts 2,3 & 4).
- They are asked to use the flipchart to summarize (or create a graphic organizer of) the information they deduced in their assigned reading text.
- The teacher explains that each expert group should do the following:

(1) Come up with a title to their reading text
(2) Identify the main idea of their text.
(3) Identify important details.
(4) Provide a 2 minutes summary presentation to the whole class.

- While students are working in their expert groups, the teacher needs to move around, ask guiding questions and make sure the students are on task.
- After 15 minutes, the teacher asks a representative from each expert group to come out and present a summary of their reading.
- Students then go back to their home groups and take turns presenting their readings in more details to the homegroup.
- Each home group is then given the following questions to answer collectively: (10-15 minutes)
  (1) Why is global warming a problem?
  (2) What is the greenhouse effect?
  (3) What causes the greenhouse effect?
  (4) What are the major greenhouse gases?
  (5) What are the primary causes of carbon dioxide emission?
  (6) Provide examples of individual activities that could result in carbon emission.
- The teacher can then discuss the homegroups answers collectively with the whole class
- The teacher can use the following video to wrap up the lesson.
  https://www.nationalgeographic.com/environment/global-warming/global-warming-overview/

Reading text 1:

Text source: https://www.teachengineering.org/lessons/view/cub_weather_lesson06

And : https://www.teachengineering.org/lessons/view/cub_footprint_lesson1

Greenhouse gases exist in the atmosphere surrounding the Earth and keep it warm. The sun gives off energy that is absorbed by the Earth. This is how our planet gets heat. Some of this heat is radiated back to space, meaning it leaves the Earth and goes out to space. When this heat travels back to space, it must pass through the Earth's atmosphere. Gases in the atmosphere absorb some of this heat, keeping the air around us warm. We call this effect the greenhouse effect and these gases are called greenhouse gases because they act like the glass roof of a greenhouse. We need these gases in the atmosphere or our planet would become too cold for us to live on. At the

same time, if too many of these gases accumulate in the atmosphere, then not enough heat can escape and our planet gets too warm.

Greenhouse gases (including CO_2, water vapor and aerosols) are found in the atmosphere above the surface of the Earth. Their job is to trap heat reflected off the Earth from the Sun. You have probably experienced the greenhouse effect while sitting in a car that is parked in the Sun. The glass windows let in light but keep heat from escaping. If it is a bit chilly out, it may feel nice to get into a warm car, but on a hot day, it can be very uncomfortable to get inside a car that is rapidly warming up in the hot Sun. (You may even open the doors and let some of the hot air escape before getting in the car.)

The same is true for the Earth. If we did not have greenhouse gases, the Earth would be 60℉ colder! That would mean it would get down to (insert your typically low temperature minus 60°F based on the weather in your area) in the winter! So, it would be safe to say then that greenhouse gases are necessary to survive in our world; but, similar to sitting in a car on a really hot day, too much trapped heat can make it difficult to survive as well. A delicate balance — between what is necessary and what is too much — is key to our survival on this planet. Even small changes in our global climate can have a big impact on how we live.

Reading text 2:

Text source:
https://ecology.wa.gov/Air-Climate/Climate-change/Climate-change-the-environment

Extreme weather
When people think of climate change, they often only consider extreme weather and rising temperatures. Extreme weather events, like frequent droughts and stronger storms, are examples of what will increasingly occur. All of these changes are emerging as humans continue to add heat-trapping greenhouse gases to the atmosphere.

Ocean acidification
When carbon pollution from human activities is absorbed by seawater, the ocean becomes more acidic. These chemical changes can threaten marine life, especially shellfish, corals, and plankton, on which larger marine life depend.

Sea level rise

Rising sea levels are a serious consequence of climate change. On average, sea levels have swelled over eight inches since 1880, with about three of those inches gained in the past 25 years. The oceans continue to absorb heat from greenhouse gases, resulting in thermal expansion, melting glaciers, and loss of polar ice sheets. Rising waters can lead to coastal hazards such as flooding and habitat changes. Inland, saltwater can contaminate wetlands, aquifers, and agricultural soils.

Water supply

Rising temperatures due to climate change means more precipitation falls as rain rather than snow, reducing snowpack levels, and

threatening water supplies for many parts of Washington. In many areas, climate change is likely to increase water demand while water supplies are shrinking. In other areas, an increase in precipitation can lead to flooding, degrading water quality and damaging communities and infrastructure.

Wildfires

Higher spring and summer temperatures due to climate change cause earlier spring snowmelt. These weather changes cause soils to be drier for longer, increasing the likelihood of drought, and turning forests into kindling, particularly in the Western United States. Wildfires threaten air quality, your health, the economy, and the environment.

Reading Text 3

Text source: https://www.livescience.com/37003-global-warming.html

Since the beginning of the industrial revolution, humans have been rapidly changing the balance of gases in the atmosphere. Burning fossil fuels like coal and oil releases water vapor, carbon dioxide (CO_2), methane (CH_4), ozone and nitrous oxide (N_2O) — the primary greenhouse gases. Carbon dioxide is the most common greenhouse gas. Between about 800,000 years ago and the beginning of the Industrial Revolution, its presence in the atmosphere amounted to about 280 parts per million (ppm). Today, it's about 400 ppm. (This number means there are 400 molecules of carbon dioxide in the air per every million air molecules.)

CO_2 makes its way into the atmosphere through a variety of routes. Burning fossil fuels releases CO_2 and is by far the primary way that U.S. emissions warm the globe. According to the EPA's 2015 report, U.S. fossil fuel combustion, including electricity generation, releases just over 5.5 billion tons (5 billion metric tons) of CO_2 into the atmosphere annually. Other processes — such as non-energy use of fuels, iron and steel production, cement production and waste incineration — boost the total annual CO_2 release in the U.S. to almost 6 billion tons (5.5 billion metric tons).

Deforestation is also a large contributor to excessive CO_2 in the atmosphere. In fact, deforestation is the second largest anthropogenic (human-made) source of carbon dioxide, according to research published by Duke University. When trees are killed, they release the carbon they have stored during photosynthesis. According to the 2010 Global Forest Resources Assessment, deforestation releases nearly a billion tons of carbon into the atmosphere per year.

Reading text 4

Text sources

Par. 1 & 2: http://www.takepart.com/flashcards/what-is-a-carbon-footprint/index.html

Par. 3: https://www.teachengineering.org/lessons/view/cub_footprint_lesson1

A carbon footprint is the amount of greenhouse gases—primarily carbon dioxide—released into the atmosphere by a particular human activity. A carbon footprint can be a broad measure or be applied to the actions of an individual, a family, an event, an organization, or even an entire nation. It is usually measured as tons of CO2 emitted per year, a number that can be supplemented by tons of CO2-equivalent gases, including methane, nitrous oxide, and other greenhouse gases.

When calculating a carbon footprint, a lot of factors are taken into consideration. For example, driving to the grocery store burns a certain amount of fuel, and fossil fuels are the primary sources of greenhouses gases. But that grocery store is powered by electricity, and its employees probably drove to work, so the store has its own carbon footprint. In addition, the products that the store sells were all shipped there, so that must also be factored into the total carbon footprint.

Each of you has a carbon footprint. Your carbon footprint is the amount of greenhouse gases that are emitted in the air because of your activities. Many activities contribute to your carbon footprint such as heating your house, how you get to school, and how much trash you throw away. Some activities emit greenhouse gases directly, such as the gas from the tailpipe of the car or bus you take to school. For other activities the greenhouse gases were emitted elsewhere, such as at the factory where your TV was made or at the power plant where the power for your lights is generated.

Activity 3: Evaluate the evidence		
Activity duration: 60 minutes	**Activity type: group work / whole class**	**Resources** ● **Lesson plan**

Activity objectives:

- Distinguish between causation and correlation.
- Understand what makes one argument more credible than the other.
- Use the fishbone diagram to brainstorm the causes of a specific phenomenon

Materials needed:

1. Solutionville student activity guide

2. Solutionville inquiry article
3. Fishbone Worksheet

Procedures:

1. Teacher explains how to use the diagram through a simple example first. The example can be as simple as brainstorming the possible causes of one of their classmates absence. This brainstorming can be done on the board with the whole class.
2. Teacher then asks students about how they determine the cause of a phenomenon accurately and how they find evidence. Possible answers can be:
    a. Through conducting research
    b. Collecting data through surveys/ interviews
    c. Making experiments and observing the phenomenon for a long time
3. Teacher then can use the students' answers to apply on the given example
4. Teacher divides the students into small groups of 3 or 4 students and ask them to read the instructions in the Solutionville student activity guide carefully. Then, they can read the solutionville inquiry article with its three hypotheses.
5. Teacher starts a discussion with the groups about which of the causes presented in the activity is more logical and led to temperature increase in solutionville. Students should explain how they decided that one cause is more logical than the other and on what basis. The following are examples for logical evidence:
    a. Collected data over a long period of time rather than data collected over a year or two
    b. Controlled experiments rather than random observations
    c. Presented argument might be for the benefit of some people, so one should be careful while trying to reach a conclusion
6. Teacher can show the students an additional evidence by playing a video called what's the deal with fossil fuels. The video can be played twice in class.
7. Teacher asks students to find a way to investigate the arguments in the video about the relationship between rising temperatures, fossil fuels and the concentration of carbon dioxide. Examples of investigation tools can be:
    a. Conduct an experiment that shows whether or not carbon dioxide traps heat
    b. Review data of fossil fuels uses over a long period of time and compare them with the level of carbon dioxide concentration over the same period.
8. Teacher writes the words ***Correlation*** and ***Causation*** on the board with their definitions
9. Teacher then tests students' understanding by asking them to go back to the solutionville inquiry article and check each hypothesis. The options can be one of the following:

a. Showing correlation
b. Showing causation
c. Showing both
d. Showing neither

Homework:

- Teacher asks students to search online for more information about the use of fossil fuels and its relationship with carbon dioxide concentrations in the atmosphere.

Engineering Design Milestone		
Duration:	**Activity type: (Group Work/ Design teams)**	**Resources**
Objectives:	Revisit initial design questions Conduct further research on the design problem as needed. Reflect on knowledge and skills acquired during phase 2. Connect acquired knowledge and skills to the design challenge	

Materials
Questions worksheet

Procedures
- Students are directed to look at the graphic organizer they created towards the end of phase 1.
- Students are encouraged to revisit the ideas and questions they have written, and think in what way their understanding of the problem has changed during phase 2.
- Groups are assigned to discuss the following questions:

What did we learn that could help us with the design solution?	Do we need to revisit our initial solution ideas? (why, where, what, who & how)	What questions we raised in milestone 1 were already answered?
----------	----------	----------
What questions do we still need to further investigate?	Do we have new questions that need further research	What existing solution could we make use of in our design?
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Phase 3 Explore Possible Solutions		
Activity 1: Evaluate different sources of energy		
Activity Duration: 60 minutes	**Activity type: group work**	**Resources** https://www.nps.gov/glac/learn/education/upload/Climate_change_MS-Unit_Final.pdf

Activity objectives:

1. Research different sources of energy.
2. Compare the benefits and disadvantages of different energy sources.
3. Differentiate between renewable and nonrenewable energy.
4. Recommend which sources are more environment friendly for future use.

Materials needed:

- Worksheets, reference Pp. 48-54
- Markers
- flipcharts

Procedures:

1. The teacher divides the class into 7 groups. Each group will be working on one energy worksheet.
2. Students are asked to individually read their assigned text. (5 minutes)
3. Each group is then asked to discuss their energy source according to the questions listed below the text, and create a poster using the flipcharts to present their findings (20 minutes)
4. Groups take turns presenting their energy source (2 minutes each)
5. Students place their posters in 7 distinctive areas in the classroom.

6. The teacher then ask the following questions and direct the students to move towards the poster that matches better with the question.
   Sample questions could include: which source do you think ..
   - Is most dangerous?
   - Produces more carbon dioxide?
   - Emits the least greenhouse gases?
   - Is the most environment friendly?
   - Is the least environment friendly?
   - Is the most expensive?
   - Is the least expensive?
7. As students move towards their chosen poster (energy source), the teacher asks them further questions to justify their choices.

Design challenge milestone		
Activity duration: 55-75 minutes	**Activity type:** Group work/ design teams	**Resources**

Activity objectives:

- Research existing solutions to the unit's problem.
- Evaluate existing solutions by identifying their strengths and weaknesses.
- Decide on ideas or technologies that could inspire the design solution.

Materials needed:

- Evaluating solutions handout
- Computers with internet access

Procedures:

- Students are asked to research (2 or 3) solutions and fill in the following table. (40 - 60 minutes
- Groups take turns presenting a brief of their findings (15 minutes)

Name of the solution	
What is the idea/ technology behind it?	
Solution strengths	
Solution drawbacks	
To what extent is this solution environment friendly? How could our design benefit from this solution?	

Phase 4
Plan for Action

Engineering Design Milestone		
Duration:	**Activity type: (Group Work/ Design teams)**	**Resources**

Objectives:

- Draw an outline of the design
- Anticipate possible constraints of the design
- Estimate expected design costs.
- Exchange feedback with other design teams

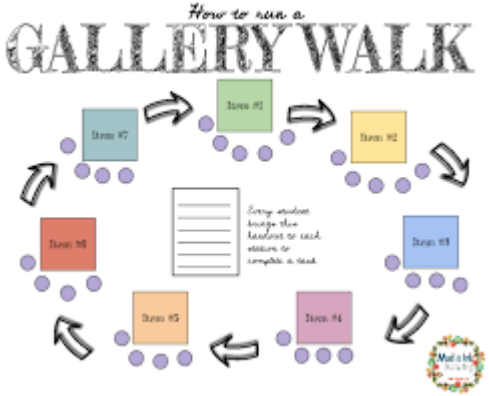
Procedures:

Stage 1 (Teams Planning/ sketching)

- Students draw (3 or 4) different outlines of a possible design

- Teams discuss the outlines and choose 1 to continue with (or create 1 hybrid design from them)
- Students think of what dimensions they want the design to be
- Students modify their designs to fit the dimensions (making sure the scale they use is proportional to the intended actual dimensions)
- Students list the materials required
- Students calculate the expected design costs
- Each team prepares a 5 minutes presentation for their design plan

Stage 2 (sharing ideas / design plans gallery walk)



Source: https://www.pinterest.com/pin/312578030372165243/

- One or two members from each team stay at the group station to present the design plans.
- Other team members move around the class to get introduced to other plans, and deliver feedback on them.
- Each group stays for 5 minutes in each station and rotate to the next upon the teacher's request (the teacher could use a whistle or claps to mark teams rotations).
- While students are in the different stations they are asked to:
    (1) Listen carefully the team's presentations.
    (2) Ask questions.
    (3) Suggest modifications.
    (4) Take notes of ideas that might help their teams.

Stage 3: homestation reflection and design modifications

- When students go back to their homestations they are asked to individually fill the following table

Things I liked	Suggestions I made	New ideas that could benefit our design

- The team presenters can use the following form

Things people liked about our design	Suggestions other students made	New ideas that could benefit our design

- Students within each team take turns sharing their thoughts on the gallery walk.
- Teams reconsider their initial designs, and make modifications as necessary
- Teams prepare a list of the materials needed and expected costs of their design.

Materials required / quantity	Where can we get it	Expected cost

Phase 5
Build, Test, Redesign

Engineering Design Milestone 5		
Duration:	**Activity type: (Group Work/ Design teams)**	**Resources**
Objectives: 1. Create an initial (prototype) version of the design. 2. Evaluate design functions with regards to specifications. 3. Redesign to solve problems in initial design and make the necessary modifications.		
Procedures 1. Each team assembles materials required for constructing the design. 2. Teacher explains that the students are going to create a prototype first. S/he explains that a prototype is a model of the design solution that is used for testing/ evaluating the design functionality before coming up with its final version. 3. Each team works on building the prototype version of the design. 4. Teams test their design, and self-evaluate it with regards to the design specifications and rubric. 5. Teams make the necessary modifications to their design and come up with the final version.		

Phase 6 Communicate & Reflect

Engineering Design Milestone 6		
Duration:	**Activity type: (Group Work/ Design teams)**	**Resources**
Objectives: 1. Present the final designs and describe the process. 2. Communicate with other teams to get feedback. 3. Reflect on the full design process.		
Procedures:		

Stage 1: Group reflection & preparation for the presentation

In their design teams students are expected to prepare for their design presentation as follows.

a) Teams need to collectively think of the following questions:

1. How did we decide on the initial design?
2. How was the initial design different from both the prototype and the final product?
3. What helped us decide on the final solution?
4. What knowledge do we believe was essential for us to arrive at our final product?
5. What challenges did we face as a group?
6. To what extent do we think we succeeded to meet the design requirements?
7. What do we need to consider for future designs?
8. How can we improve future group work?

b) Teams get to prepare a powerpoint (or a poster) presentation that includes the following:

1. Summary of the problem/ design challenge.
2. Essential knowledge needed for the design/ the idea behind the design.
3. Context & target audience.
4. Description of the model/ design.
5. Strengths and weaknesses in the design.
6. Team's evaluation of the process.

Stage 2: Presenting and communicating feedback

1. Groups take turns doing their whole class presentations (8-10 minutes per group).
2. Each presentation can be followed by questions and answers from the rest of the class.
3. Presentations can also be done as a gallery walk activity.

Stage 3: Individual reflection.

After presentations and team feedback, students sit individually work on the following:

1. How do you feel about the entire process?
   ……...……..……
2. To what extent are you satisfied with your participation within the design teams?
   ……...……..……
3. I think our design is able/ not able to solve the problem identified at the beginning of the project because
   ……...……..……
4. My favorite part of the design was
   ……...……..……
5. If we started the process again, I would
   ……...……..……
6. Next time I work in a group I want
   ……...……..……

Engineering Challenge Rubric

Student will be able to	Novice 1	Apprentice 2	Proficient 3	Distinguished 4
Identify and implement the steps of the Engineering Design Process.	Student does not successfully identify or implement the steps of the Engineering Design Process.	Student identifies and implements at least some steps of the Engineering Design Process. Some aspects of implementation are missing, incomplete, or incorrect.	Student correctly identifies and implements at least four steps of the Engineering Design Process independently.	Student performs at proficient level and goes significantly beyond, for example by showing productive flexibility in application.

Use prior knowledge of water properties, changes of matter, electric circuit, solar cells; determine the rate of some process to inform machine design.	Student does not successfully use prior knowledge in the Engineering Design.	Student uses prior knowledge Engineering Design. Not all information is correctly used, or student needs significant support.	Student correctly and completely uses prior knowledge.	Student participates at proficient level and goes significantly beyond, for example by identifying additional information that would help inform their device.
Test and analyze the device of desalination of seawater for strengths and weaknesses.	Tests are poorly conducted and recorded; student is unable to analyze strengths and weaknesses of the machine without help.	Tests are somewhat well conducted and recorded; student analyzes a few strengths and weaknesses of the machine design but may need some support.	Tests are carefully conducted and recorded; student analyzes many strengths and weaknesses of machine design.	Student participates at proficient level and goes significantly beyond, for example control the rate of evaporation and condensation of the water
Improve the machine design based on earlier analysis.	Student does not improve design based on earlier analysis.	Student is able to make few improvements on earlier analysis.	Student makes significant improvements based on analysis of test results.	Students perform at proficient level, and go significantly beyond, for example redesigning the machine to minimize the tools used.
Reflection	Student does not provide a good reflection on the Engineering Design Process, and does not relate the process with prior knowledge of change states of matter and light reflection	Student provides a reflection on the Engineering Design Process, but does not completely relate the process with prior knowledge of connections	Student provides a good reflection, which relates his/her prior knowledge of electrical connections and using light reflection phenomenon with the Engineering Design Process.	Student provides an elaborate reflection, in which he/she discusses how the natural world can be replicated in the designed world using Engineering Design Process.

Group work	Student does not collaborate with peers, and does not give feedback or participate in the Engineering Design Process within his/her group.	Student works with group members, but does not show willingness to communicate and collaborate with peers.	Student works well with his/her group, participating and giving feedback throughout the Engineering Design Process.	Student shows leadership qualities, facilitating the Engineering Design Process for his/her peers, showing good communication skills and collaboration.

* Scoring sheets adapted from Engineering is Elementary rubric.