

Global Climate Change Unit February-March, 2016 Honors Chemistry Dr. Rose Davidson		Major Due Dates: <b>Day 4</b> Rough draft of Infographic on Trend, Evidence, Impact due <b>Day 14</b> Infographic on Global, Local, Individual due	
<b>Essential Questions:</b>			
<ul style="list-style-type: none"> <li>How has the combustion of fossil fuels impacted the carbon cycle and changed the flow of energy in the environment?</li> <li>How is global climate change modeled and predictions for the future made?</li> </ul>			
Date	Objectives covered on the Unit Assessment	Activities	Homework
Days 1-4	Students will be able to provide evidence of global climate change and its impact on global systems. Students will be able to communicate their research findings by creating an infographic.	Research project Trend, Evidence, Impact	Team research and infographic creation.
Day 5	Students will be able to communicate their findings during a Gallery Walk presentation of their infographic	Gallery Walk	Revise infographic and submit it for teacher feedback.
Day 6	Students will be able to describe how they themselves contribute to Global Climate Change.	Carbon Footprint calculator	Read and take notes on 22.5 and 24.1 in text on carbon chemistry
Day 7	Students will be able to describe how changes made at the global, local and individual level can mitigate human impact on the carbon cycle.	Video and guided discussion	Begin team research
Day 8	Students will be able to describe how changes made at the global, local and individual level can mitigate human impact on the carbon cycle.	Research changes that can be made	Team research
Day 9-12	Students will prepare an infographic to communicate the changes needed at the global, local and individual levels to mitigate human impact on the carbon cycle.	Complete research and prepare infographic	Research and infographic creation.
Day 13	Students will polish their infographic and prepare their presentation for the Gallery Walk	Finalize infographic	Finalize infographic
Day 14	Students will communicate the findings of their research in an infographic.	Gallery walk	Read and take notes on next unit in text
<b>Academic Vocabulary:</b>			
photosynthesis respiration combustion carbohydrate	fossil fuels coal propane octane methane	solid waste dissolved carbon dioxide organic carbon compounds fossil fuels coal propane, octane, methane	glacier ice sheet acidification ice core
<b>Assessment: The two infographics created will comprise the assessment for this unit.</b>			

Trends, Evidence and Impacts of Global Climate Change  
Infographic Project  
Dr. R. Davidson, 2016

Objective:

- You will understand and be able to describe how human combustion of fossil fuels has impacted the climate of planet Earth and the long term consequences of that impact on the environment and ecological communities.

Outcomes:

- You will locate global scientific climate data, analyze trends in the data and then determine if the trends in the data support the hypothesis that global climate change is occurring and impacting Earth's biosphere.
- You will be able to describe the impact which global climate change events are having on the environment and natural systems of Earth.
- You will represent your understandings about trends in global data, evidence of global climate change and the impacts that it is having on natural systems using an infographic which contains images, statistical information in the form of graphics and minimal text.
- You will defend your understanding during a Gallery Walk of the infographics prepared by the members of the class.

Student Directions:

1. Begin by reading the online booklet *Climate Change: Evidence, Impacts, and Choices* by the National Research Council which is available at:  
[http://nas-sites.org/americasclimatechoices/files/2012/06/19014\\_cvtx\\_R1.pdf](http://nas-sites.org/americasclimatechoices/files/2012/06/19014_cvtx_R1.pdf)
2. Watch the video, *Climate Change: Lines of evidence from the National Academies of Sciences, Engineering and Medicine* Available at: <https://www.youtube.com/watch?v=gIUN5ziSfNc>
3. Working with a partner or alone you will choose one of the evidences of global climate change to research. Each group or student working alone must have a unique topic. These are listed in the table below and will be selected first come, first served on through the google doc link which was sent to you via email. You are asked not to change or delete anyone else's name beside your own on this shared document.
4. You and your partner will research your chosen topic using credible sources and then prepare a one page infographic on that topic to present to the class during a gallery walk.
5. Your research gathered and presented on the infographic should contain the following content about the evidence chosen:
  - a. The trend in the evidence over time is determined and clearly and correctly described.
  - b. The change over time for that evidence is correctly illustrated graphically.
  - c. The impact which that event is having on Earth's systems is fully represented graphically, pictorially or with succinct descriptions. Earth systems include the biosphere, the atmosphere, the lithosphere and hydrosphere.
6. Your research findings are creatively composed into a one page infographic which is 8.5 x 11 inches in size. Make your infographic interesting and eye catching. The final infographic will be saved as a PDF and then uploaded through Blackboard.

7. The Venngage program will be used to create the infographic, the final submitted project must be PDF file formatted to 8.5 x 11 inches with all students' last names provided in the file name. You should have your login information for the educational version of Venngage which was used in the fall.
8. The sources of the information and images, besides being attributed on the infographic itself, are to be cited on a separate word document which is also uploaded through Blackboard on the due date.
9. The quality of the sources used for your information, the quality of the information presented and the quality of the infographic itself are all features which will impact your grade on this project. Specifics are detailed on the Specification Sheet.
10. It is your team's responsibility to insure that all members have access to the final product and are prepared for their presentation during the gallery walk which will take place on **February 29**.

<b>Choices for Evidences to Examine:</b>	
A	Carbon Dioxide levels in Ice Cores from Antarctica and Greenland
B	Sea Level measurements
C	Global Temperatures
D	Ocean Temperatures
E	Great Lake Temperatures
F	Size of ice sheets in Antarctica and Greenland
G	Size of arctic sea ice
H	Size, length of glaciers
I	Number of extreme weather events: heavy downpours
J	Number of extreme weather events: floods
K	Number of extreme weather events: tornados
L	Number of extreme weather events: hurricanes
M	Number of extreme weather events: droughts
N	Number of extreme events related to weather: forest fires
O	Number of extreme events related to weather: heat waves
P	Ocean acidification
Q	Amount of snow cover
R	Changes in seasonal migration patterns
S	Changes in animal or plant populations: extinctions and near extinctions
T	Extent of deserts: desertification
U	Increase in insect borne diseases
V	Spring's arrival: length of the frost free season
W	The Maldives Islands in crisis

**Additional Resources:**

<http://www.nrdc.org/globalwarming/climatebasics.asp>  
[http://www.ucsusa.org/global\\_warming#.VrjZmfkrLrc](http://www.ucsusa.org/global_warming#.VrjZmfkrLrc)  
<http://climate.nasa.gov/evidence/>  
<http://nca2014.globalchange.gov/>

<https://www.skepticalscience.com/evidence-for-global-warming.htm>  
<https://www.ncdc.noaa.gov/indicators/>  
<http://www.ipcc.ch/>



<b>Trends, Evidence and Impacts Infographic Scoring Guide</b>	
<p>Excellent: meets all described features completely and shows originality and creativity using additional features that add to the presentation. The information is presented at the honors, high school level of rigor.            Adequate: meets all the described features but is lacking in originality, creativity, or rigor.            Needs Improvement: the coverage is lacking key facets of the material or formatting features.            Missing: the presence of that particular feature is not found and all points will be deducted.</p>	
<b>Content Features</b>	<b>20 Points possible</b>
<ul style="list-style-type: none"> <li>• The science content represented in the infographic has significance and is appropriate to the topic. Extraneous, nonessential or nonscientific information which detracts is not included. All content is from credible sources.</li> <li>• The trend in the evidence is clearly and correctly stated; what it shows about changes over time.</li> <li>• The changes over time are correctly illustrated using a graph.</li> <li>• The impact which that trend is having on earth’s systems which include the biosphere, the atmosphere, the lithosphere and the hydrosphere are fully represented.</li> </ul>	Excellent = 20 Adequate = 16-19 Needs Improvement = 12-16 Missing = < 12
<b>Quality, Layout and Formatting Features</b>	<b>20 points possible</b>
<ul style="list-style-type: none"> <li>• The infographic has a descriptive title and an opening sequence which serves as a hook for the audience: the intent, purpose is made clear for the audience. The information flows with the main, most important ideas given prominence.</li> <li>• The content is presented in a unique, dynamic and creative manner through the use of graphics such as pictures, tables, graphs, word art.</li> <li>• The artistic quality of graphics does not detract from their presentation. Images are crisp and appropriate to the topic. Text is clear and legible. Color choices, font size and format are appropriate to the topic and overall presentation.</li> <li>• Images are copyright free or student created. Student or the artist is given credit beneath the image. Care and effort is taken with hand drawn images.</li> <li>• The mathematical relationship between quantities or properties is shown graphically not in tables. Graphs and tables are properly formatted. Understandable and accurate labels and units are included on graphs and tables. All graphs or tables are created by the students, and the information used to create them is credited beneath the graphic.</li> </ul>	Excellent = 20 Adequate = 16-19 Needs Improvement = 12-16 Missing = < 12
<b>Citing Sources</b>	<b>5 points</b>
<ul style="list-style-type: none"> <li>• Multiple, <u>credible</u> sources of data and information are used.</li> <li>• The name and date of each source of information is cited below the element in which it is used in font size 6 or 8.</li> <li>• The full MLA formatted work cited is provided as a separate word document with the URL provided for each electronic source. This document includes a heading and is final, not draft quality</li> </ul>	Excellent = 5 Adequate = 4 Needs Improvement = 3 Missing = < 2
<b>Gallery Walk Presentation</b>	<b>5 points</b>
<ul style="list-style-type: none"> <li>• Each member of the team is available and presents during the gallery walk.</li> <li>• Presentations are prepared in advance and are the same for each presenter.</li> <li>• Presentations are crisp, clean and last no more than 2 minutes.</li> <li>• Team members are respectful of audience members and of other student’s presentations.</li> </ul>	Excellent = 5 Adequate = 4 Needs Improvement = 3 Missing = < 2
<b>Total Points Possible</b>	<b>50 points</b>



Global, Local and Individual Changes to Mitigate Global Climate Change  
Infographic Project  
Dr. R. Davidson, 2016

Objectives:

- You will understand how human activities have interrupted the natural carbon cycle on Earth.
- You will understand how Earth's climate is changing as a result of changes to the carbon cycle.
- You will understand how changes made at the global, local and individual level can mitigate human impact on the carbon cycle.

Outcomes:

- You will locate global scientific climate data which illustrate the impact, and the extent of the impact which a specific human activity is having on the climate of our planet and the natural systems.
- You will be able to describe the impact which humans are having on the environment and natural systems of Earth.
- You will locate recommendations made by expert scientists of steps which can be taken to mitigate the impact which humans are having on Earth's system.
- You will describe changes in human activities which can take place at the global level, the local level and the individual level to mitigate the impact of human activity on Earth's system.
- You will communicate your research findings by creating an infographic.
- You will defend your understanding during a Gallery Walk of the infographics prepared by the members of the class.

Student Directions:

1. Watch the video, Keeping up with Carbon, available at:  
<https://www.youtube.com/watch?v=HrIr3xDhQOE>
2. Complete the carbon footprint activity available at: <http://www.earthday.org/take-action/footprint-calculator/> or <http://coolclimate.berkeley.edu/calculator> or <http://www3.epa.gov/carbon-footprint-calculator/>
3. Teams of one or two students will gather information on one of the human activities listed in the table below. These are human activities which are impacting the natural carbon cycle. Select one of these human activities to explore and sign up on the google document using the link posted on Blackboard. Each team must have
4. The team will determine the mechanism by which that human activity contributes to global climate change.
5. The team will determine changes which could be made on the global level, USA, to reduce the impact of that human activity on the global climate.
6. The team will determine changes which could be made on the local, St. Louis and Missouri level to reduce the impact of that human activity on the global climate.
7. The team will determine changes which could be made on the individual, family level to reduce the impact of that human activity on the global climate.
8. The team will create an infographic which communicates the changes which could be made globally, locally and individually to reduce the impact of that human activity on the global climate.

9. The Venngage program will be used to create the infographic, the final submitted project must take the format of a pdf file formatted to 8.5 x 11 inches.
10. This infographic will be presented in a gallery walk and must be submitted to Dr. Davidson by the deadline so that it can be printed in advance. Late infographics or work cited will not be accepted.
11. It is your team's responsibility to insure that both team members have access to the final product and are prepared for their presentation during the gallery walk

<b>Human Activity Choices</b>	
A	Use of petroleum for transportation
B	Reliance on the individual automobile for transportation
C	The life style preference of many individuals to own larger, luxury, sport utility vehicles.
D	The life style preference of many individuals to take many vacation trips via airplanes, cars and trains each year.
E	The lifestyle of many individuals to throw away or replace rather than maintaining electrical devices, cars, household appliances
F	Use of coal to generate electricity
G	The heavy reliance on electricity for heating, and cooling our homes
H	Use of coal in manufacturing goods for human use
I	Use of non-renewable resources as materials for manufactured goods
J	The high consumer mentality of most humans: buy lots of stuff, always have the latest gadget
K	Urban sprawl: replacing green space with cities and homes
L	The life style preference of many humans to own big homes/estates with large lots and grass lawns
M	Replacement of natural habitats with cropland and grazing areas to provide food for humans
N	Run off of sediments and pollutants into natural waterways and eventually the ocean caused by farming to provide food for humans and construction to provide homes for humans
O	Use of wood in fireplaces and cooking fires
P	The meat-centric diet of most humans
Q	The fast food/processed food heavy diet of most humans
R	Use of wood for paper products
S	Use of methane in furnaces to heat homes and water
T	The failure of most humans to systematically reduce, reuse and recycle manufactured goods.
U	The production of methane by grazing cattle (reliance on meat based diet)
V	Homes and Buildings that are not energy efficient, do not retain heat

**Resources:**

<http://www.nrdc.org/globalwarming/gsteps.asp>  
<http://www.ucsusa.org/our-work/global-warming/solutions/global-warming-solutions-reduce-emissions#.VsXZ1vkrJD8>  
<http://www3.epa.gov/climatechange/wycd/>

<https://www.skepticalscience.com/global-warming-too-hard.htm>  
[http://ec.europa.eu/clima/policies/international/negotiations/paris/index\\_en.htm](http://ec.europa.eu/clima/policies/international/negotiations/paris/index_en.htm)



Global, Local, Individual Infographic Scoring Guide	
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Examples of Student Work

## Ocean Acidification

The harmful impacts on the oceans through excessive exposure to Carbon Dioxide resulting in reduced pH levels.

By Kaitlin (University of New Mexico)

### Carbon Dioxide in our Oceans

66 million tons of Carbon Dioxide is produced each day through the burning of coal, oil, and gasoline.

**1/3 of Carbon Dioxide is absorbed by the ocean**

carbon dioxide (CO<sub>2</sub>)

carbon dioxide (CO<sub>2</sub>)

ocean (O<sub>2</sub>)

oceanic acid (H<sub>2</sub>CO<sub>3</sub>)

### Trends in Ocean Acidification

**The Change of Ocean pH Over Time**

1980 1985 1990 1995 2000 2005 2010

**Projected Ocean Acidity by 2100**

1980 1990 2000 2010 2020 2030 2040 2050 2060 2070 2080 2090 2100

### Impact

**Biosphere**

- Marine organisms are suffering reproductive failure, energy loss, and shell damage.
- Coral reefs are more fragile and slow.

**Lithosphere**

- Carbonic acid dissolves into many ways and forms Carbonic Acid.
- This dissolved carbon acid can be carried to the bottom.

**Hydrosphere**

- As more Carbon Dioxide is produced, more Carbonic Acid is produced.
- The Oceans become more acidic.

**FLORIDA KEYS**

1980 2016

## Global Temperature Change

By: Cambrie Gielow

1920

Temperature Difference (Fahrenheit)

**Temperatures in 1920 vs. 2015**

2015

Temperature Difference (Fahrenheit)

**16 years with the highest anomalies since 1920\***

**Years with Highest Global Temperature Anomalies**

1998 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015

By: National Centers for Environmental Information January 2016

**Earth's Systems**

**Atmosphere & Biosphere:** releasing carbon dioxide and methane into the atmosphere, causes the heat outgoing from the earth to be reflected back.

**Hydrosphere:** As the earth warms the glaciers melt and the oceans expand.

**Lithosphere:** As the oceans expand, land beings to flood.

Methane (CH<sub>4</sub>)

Carbon dioxide (CO<sub>2</sub>)

**Annual Mean of Global Temperatures Yearly**

By: NASA Global Climate Change, January 2016

\*Anomaly- how far away the temperature was from what it was supposed to be



## Size of Arctic Sea Ice

*By Kristen Weber and Caroline Zupan*

Minimum Arctic Sea Ice Extent vs. Year

Source: NOAA

From 2000-2015, the average ice decreased 12% per decade.

Source: NOAA

The ice reaches its minimum each September.

Source: NASA

Temperatures in the Arctic are rising twice as fast as they are elsewhere.

Source: MDC

Difference of Arctic and Global temperature from 1981-2010 Averages vs. Year

Source: NOAA

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### Arctic Polar Ice Cap

Permanent ice cover in the polar ice cap

↓ 10%

each decade. At this rate, summers in the Arctic will be free of ice by 2100.

Source: MDC and National Research Council

Summer Arctic Sea Ice Boundary in 1979

Pictured: comparison of ice cover in the polar ice cap in 2005 and ice cover in 1979 (outlined in red)

Source: MDC

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### Impacts on Biosphere/Hydrosphere

#### Rising Sea Levels

Threaten indigenous humans, animals (polar bears, walruses, seals, etc.), and plants.

Polar bears are especially affected by altered habitats. The population will decrease 66% by 2050.

Source: National Research Council, MDC, WWF, and Time

#### Global Warming: the Positive Feedback Loop

As ice cover decreases, more of Earth's dark land and water (areas which absorb sunlight) is exposed to sunlight.

**Effect:**

- Increased temperatures
- Increased perpetuation of global warming

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#### Impacts on Lithosphere/Biosphere

It will negatively impact Kansas farmers, whose plants require cold Northern winds and sufficient soil moisture

The warming of the Arctic region will affect weather patterns and food production.

They need the moist soil and cold wind to grow the state's cash crop: wheat.

Source: MDC

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### The Ward Hunt Ice Shelf

- Largest single block of ice in the Arctic for 3,000 years. Located on the north coast of Ellesmere Island in Canada, about 800 km from the North Pole.
- Ruptured in 2000; by 2015 broke into pieces.
- Its disintegration contributes to rising sea levels and threatens biospheric activity.

Source: MDC

Source: NASA

By Rose Gier and Marissa Quinn

# GLOBAL CLIMATE CHANGE — Made Local —

**How does driving your car affect climate change?**  
The burning of fossil fuels like gasoline releases carbon dioxide, a greenhouse gas, into the atmosphere. When everyone has their own car, carbon dioxide is emitted in enormous amounts.

**Factors of U.S. Greenhouse Gas Emissions (2014)**

Factor	Percentage
Transportation	27.0%
Electricity	31.0%
Industry	21.0%
Agriculture	9.0%
Commercial	6.0%
Residential	6.0%

**Changes you can make...**

**LOCALLY**

- Local communities can build more bike paths in their area to encourage and increase the use of bikes over driving a car.

**INDIVIDUALLY**

- Take public transportation or ride your bike whenever possible.
- Carpool with friends to reduce carbon dioxide emissions from multiple cars.

**GLOBALLY**

- Countries could provide incentives of purchasing fuel-efficient cars to conserve fuel.

## Reducing Coal and Electricity Generation to Decrease Global Climate Change

By Katie Huxton and Kristen Weber

**Energy Generation vs. Year in the U.S.**

**Coal Use**

Coal plays a vital role in electricity generation worldwide.

Coal-fired power plants currently fuel 41% of global electricity.

By 2030 more than 1/3 of our nation's electricity supply is estimated to be from the wind and the sun alone.

**Why is the use of Coal a Problem?**  
It directly leads to air pollution, waste generation, a need for an abundant water supply, climate change, and more mercury in the environment.

Producing more electricity from less coal = Reducing CO<sub>2</sub>

**Global Action**  
Close coal plants  
& Use better, cleaner energy sources

**Local Action - Missouri**  
Spend \$435 million on coal exportation  
One of many options to use that money to invest in more hydropower use from many rivers in Missouri

**Individual Action**  
Be more energy efficient

- Switch to fluorescent or LED bulbs
- Save energy! Turn off air conditioner and fans
- Switch to energy efficient appliances

