

Title: Global, Local and Individual Changes to Reduce Global Climate Change

Course Title: Honors Chemistry (required, year long course)

Grade Level: 11th

Time: Four class meetings (three are 45 minutes, one is 75 minutes) over a 1 week period

Resources, Materials, Technology:

- Students use their own laptops to research online (one to one laptop school).
- PowerPoint and Microsoft Publisher are used to create the infographic.
- Infographics are converted to PDF files.
- Microsoft word is used to create the MLA Work Cited document.

Standards addressed:

- NGSS Practices: 1,2,3,4,5,6,7,8
- NGSS Crosscutting concepts: Patterns, Cause & Effect, Systems & System Models, Energy & Matter, Stability & Change
- NGSS DCI: HS-LS1-5, HS-LS1-7, HS-LS2-3, HS-LS2-4, HS-LS2-5, HS-LS2-7, HS-ESS2-4, HS-ESS2-6, HS-ESS3-1, HS-ESS3-4, HS-ESS3-5, HS-ESS3-6

Learning Objectives/ Outcomes:

- Students will understand the mechanisms and specific human activities which contribute to global climate change.
- Student will determine changes which could be made on the global, international level to reduce the impact of a specific human activity on the global climate.
- Students will determine changes which could be made on the local, St. Louis or Missouri level to reduce the impact of a specific human activity on the global climate.
- Students will determine changes which could be made on the individual, family level to reduce the impact of a specific human activity on the global climate.
- Students will represent their understandings about strategies to reduce the impact of human activity on natural systems using an infographic which contains images, statistical information in the form of graphics and minimal text.

Previous lessons on which this builds:

- Students, in the **Chemical Equations** unit will have learned about the combustion of fossil fuels and that carbon dioxide and water are the two main products of their combustion.
- In a previous lesson in the current, **Global Climate Change**, unit the students will have reviewed the carbon cycle which was discussed in their biology course the previous year.

- The Greenhouse Effect will also be discussed along with identifying the two products of combustion, carbon dioxide and water vapor, as significant greenhouse gases.
- Students have researched the evidences which support the hypothesis that human activity is resulting global climate change in a previous infographic activity in the unit.
- Students have been trained in a required Digital Literacy course in how to carry out online searches, how to use Microsoft Word, PowerPoint and Publisher.
- Google docs and Google slide have also been introduced to the students and many choose to use this for sharing during group or team projects.
- Blackboard is used within the school to transmit files between teacher and student.
- Within this course previously the students have created line graphs and bar graphs.

Lesson Structure and Procedures:

Before the Lesson

- Students have presented their Trend, Evidence and Impact infographics in a gallery walk.
- At the end of the gallery walk activity, students participated in a class brainstorming session on the ways that humans are adding to the greenhouse gases and global climate change.
- Once the prior knowledge of the students on this subject is exhausted the student are allowed time to use their computers to investigate additional human activities that are impacting global climate that are added to the list.
- Using search terms such as human activity global climate change, climate change, carbon dioxide, and greenhouse gases, reducing human impact, reducing global climate change, reducing global warming, a variety of topics emerges. The goal is to have as many topics or more than the student groups in the class.
- This brainstormed list forms the backbone for the topic selection activity which takes place on Day 1.

Day 1: 45 minutes in length

- The focus of this period is the familiarization of the students with the project expectations:
 - Teams of two students will gather information on one of the human activities listed in the table below.
 - The team will determine the mechanism by which that human activity contributes to global climate change.
 - The team will determine changes which could be made on the global level to reduce the impact of that human activity on the global climate.
 - 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.

- 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.
- 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.
- Students are introduced to the infographic assignment. They are given the list of brainstormed topic ideas along with the student direction sheet (attached).
- Students select a partner with whom they want to work on the project. Each team is given a number selected by random which determines their position in the choosing of topics.
- Once each team has a topic, the format of an infographic is described by the teacher.
- Examples of infographics are presented. At this point only a vague sense of the format, designing of an infographic is held by the students.
- The details of the content needed for their infographic is discussed using the student direction sheet (attached) as a guide.
- Students are then given the remainder of the period to begin researching their topic.
- During this time the teacher circulates to each team to verify that they understand the task at hand and are making progress on collecting information.
- At the end of the period they are encouraged to continue their research for homework and to bring the results of their searches to class the next day.

Day 2: 45 minutes in length

- The focus for this class period is forming the connection between the students and the information that they are gathering.
- The class begins with a check point discussion where students are asked to share what they have learned so far about their topic. Each team is probed to describe the impact which the human activity that they are researching has on the environment and ways in which that impact could be reduced.
- Students are then shown how to carry out a search using Google to locate images which are copyright free and therefore able to be used on their infographic.
- Students continue working on their collecting of content and now images with the teacher available to discuss any area of concern.
- During this period the teacher circulates to each team to verify that they not only are collecting information but beginning to synthesize it into new understandings of how the impact of global climate change on natural systems can be reduced by changing human behavior.
- At the end of the period they are encouraged to continue their research for homework and to bring the results of their searches to class the next day. They should arrive for class with all of the information and images that they feel they will need in order to create their infographic.

Day 3: 75 minutes in length

- The focus for this class period is the creation of the infographic itself.

- Students are shown examples of previously created infographics on other topics using the PowerPoint and Publisher format.
- The logistics of sharing pictures and information with their partner are discussed and worked through.
- Students are given the entire period to create their infographic; compiling their information, creating graphs of their statistics and then working on the artistic design and presentation format.
- Students are directed to continue working on their collecting of content and now images with the teacher available to discuss any area of concern.
- During this period the teacher circulates to each team to help with formatting and design issues that arise.
- At the end of the period students are reminded that the completed infographic, along with the MLA formatted work cited are due before 8 AM on the next class period. This will allow the teacher time to print out the infographics for the Gallery Walk which will take place during the next class period.
- Students are also reminded of the teacher's availability to help with any issue which arises during the intervening days. (This project was set up to have a weekend of team work time available between the infographic work day and the Gallery Walk).

Day 4: 45 Minutes in length

- The focus for this class period is the presentation of the infographic by the student during a Gallery Walk which is in a Speed Dating format.
- The infographics are displayed on the walls in the hallway outside of the classroom by the teacher before the class takes place.
- The students are divided into two groups with one member of each team on each group.
- The first group will present their infographics, they are asked to go out in the hallway and stand next to their infographic. The second group will serve as audience members. They will each pair up with one of the presenters. Every two-three minutes the audience will circulate, in a pattern, to the next presenter.
- During the presentation time the teacher circulates to listen to the presentations and to gauge when the next shift should occur.
- After each presenter has been heard by the majority of the audience members, the audience switches to become the presenters and the presenters become the audience. The process of presenting then shifting begins again and continues until the majority of the presenters have been heard by each member of the audience.
- At the end of the period, or at the beginning of the next one if time has run out, the class has a recap of what was learned from this experience. Finally, the students are asked to vote for their favorite presentation. They are asked to explain why they made the choice that they did.

Student directions/handouts:

Global, Local and Individual Changes to Reduce Global Climate Change

Objectives:

- You will understand the mechanisms and specific human activities which contribute to global climate change.
- You will determine changes which could be made on the global, international level to reduce the impact of a specific human activity on the global climate.
- You will determine changes which could be made on the local, St. Louis or Missouri level to reduce the impact of a specific human activity on the global climate.
- You will determine changes which could be made on the individual, family level to reduce the impact of a specific human activity on the global climate.
- You will represent your understandings about strategies to reduce the impact of human activity on natural systems using an infographic which contains images, statistical information in the form of graphics and minimal text.

Student Directions:

1. Working with a partner, you will choose one of the human activities which is adding to global climate change which resulted from our class brainstorming session to research. These are listed below.
2. You and your partner will research your chosen topic and then prepare a one page infographic on that how that human activity could be modified to reduce global climate change. The infographic will be presented to the class during a gallery walk.
3. Your research gathered and presented on the infographic should contain the following content about the human activity chosen:
 - The mechanism by which that human activity contributes to global climate change is fully described.
 - The changes which could be made on the global, international, level to reduce the impact of that human activity on the global climate are represented fully.
 - The changes which could be made on the local, St. Louis or Missouri, level to reduce the impact of that human activity on the global climate are fully represented.
 - The changes which could be made on the individual, family level to reduce the impact of that human activity on the global climate are fully represented.
4. Your research findings are creatively composed into a one page infographic which is 8.5 x 11 inches in size. Microsoft Publisher is great for this. Make your infographic interesting and eye catching. The final infographic will be saved as a PDF and then uploaded through Blackboard.
5. While any program can 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.
6. The sources of the information and pictures are cited on a separate word document which is also uploaded through Blackboard.
7. 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.

8. 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.

Human Activities:	
A	Use of petroleum for transportation
B	Reliance on the individual automobile for transportation
C	Use of coal to generate electricity
D	Use of coal in manufacturing goods for human use
E	Use of non-renewable resources as materials for manufactured goods
F	Urban sprawl: replacing green space with cities and homes
G	Replacement of natural habitats with cropland and grazing areas
H	Run off of sediments and pollutants into natural waterways and eventually the ocean
I	Use of wood in fireplaces and cooking fires
J	Use of wood for paper products
K	Use of methane in furnaces
L	The production of methane by grazing cattle (reliance on meat based diet)
M	Homes and Buildings that are not energy efficient, do not retain heat
Global, Local, Individual Infographic Scoring Guide	
<ul style="list-style-type: none"> • 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. • Present meets all the described features but is lacking in originality, creativity, or rigor. • Needs Improvement means that the coverage is lacking key facets of the material or formatting features. • Missing means that the presence of that particular feature is not found and all points will be deducted. 	
Content Features	20 Points possible
<ul style="list-style-type: none"> • 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. • The mechanism by which that human activity contributes to global climate change is fully described. • The changes which could be made on the global level to reduce the 	Excellent = 20 Present = 16-19 Needs Improvement = 12-16 Missing = < 12

<p>impact of that human activity on the global climate are represented fully.</p> <ul style="list-style-type: none"> • The 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 are fully represented. • The changes which could be made on the individual, family level to reduce the impact of that human activity on the global climate are fully represented. 	
Quality, Layout and Formatting Features	20 points possible
<ul style="list-style-type: none"> • 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. • The content is presented in a unique, dynamic and creative manner through the use of graphics such as pictures, tables, graphs, word art. • 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. • Images are created or taken by the students and the artist is given credit beneath the image. Care and effort is taken with hand drawn images. • 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. 	<p>Excellent = 20 Present = 16-19 Needs Improvement = 12-16 Missing = < 12</p>
Citing Sources	5 points
<ul style="list-style-type: none"> • Multiple, <u>credible</u> sources of data and information are used. • The name of each source of information is cited below the element in which it is used in font size 6 or 8. • 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 	<p>Excellent = 5 Present = 4 Needs Improvement = 3 Missing = < 2</p>
Gallery Walk Presentation	5 points
<ul style="list-style-type: none"> • Each member of the team is available and presents during the gallery walk. • Presentations are prepared in advance and are the same for each presenter. • Presentations are crisp, clean and last no more than 2 minutes. • Team members are respectful of audience members and of other student's presentations. 	<p>Excellent = 5 Present = 4 Needs Improvement = 3 Missing = < 2</p>
Total Points Possible	50 points
	(100 points is the normal weight of a test in course)

Follow Up/Extensions:



- Student projects can be displayed in the school and viewed by the school community.
- Student projects could be written about in the school paper with examples given to illustrate and to spark a debate about changes in behaviors to reduce global climate change.
- Students can be asked to write a reflection on what they found most memorable about their own topic of research and why.
- Students can be asked to write a reflection on which of the topics presented by their peers was most memorable and why.
- Student projects on changing human actions to reduce global climate change can be discussed within their Social Studies courses with citizen involvement as the theme. Questions such as, “Should the US be changing our energy production strategies order to decrease our reliance on fossil fuel?” could be posed to spark these discussions in the Social Studies course or as a follow up discussion in the science classroom.

Examples of student work:



HOOKED ON CARS

How is our dependency on automobiles affecting climate change and how can we become less dependent?
 By: Megan Schutte and Emily Strout

AS OF 2010 THERE WERE ESTIMATED **1.015 BILLION** MOTOR VEHICLES IN THE WORLD
 (Huffingtonpost.com)

GASOLINE RELEASES **19.564 POUNDS OF CO₂** PER GALLONS BURNED
 (U.S. Department of Transportation)



http://upload.wikimedia.org/wikipedia/commons/4/cb/Automobile_exhaust_gas.jpg

IF JUST **1 DRIVER PER HOUSEHOLD** SWITCHED TO PUBLIC TRANSPORTATION FOR 10 MILES EACH WAY, IT WOULD SAVE **4,627 POUNDS OF CO₂** PER HOUSEHOLD PER YEAR—

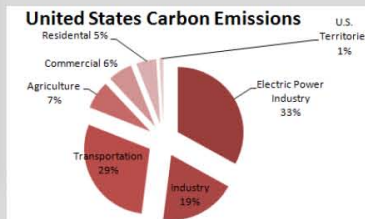
↓
 EQUIVALENT TO AN **8.1% REDUCTION** IN THE ANNUAL CARBON FOOTPRINT OF A TYPICAL AMERICAN HOUSEHOLD.
 (U.S. Department of Transportation)

WHAT?



<https://encrypted-tbn1.gstatic.com/images?q=tbn:ANd9GcTGZ5xyeghVeiWwzqJFsqTwiNK2y8ovsqwOfD6nYDaGyeT6r-1>

HUMANS AROUND THE WORLD ARE DEPENDENT ON AUTOMOBILES WHICH CONTRIBUTE TO THE WORLD'S INCREASING LEVELS OF CARBON DIOXIDE LEADING TO CLIMATE CHANGE



(U.S. Department of Transportation)

ABOUT **15 PERCENT** OF MANMADE CARBON EMISSIONS COMES FROM VEHICLES
 (Biologicaldiversity.org)

GLOBALLY



(Photo credit: Emily Strout)

TO DECREASE EMISSIONS GLOBALLY:

- REGULATE PARKING AND DRIVING IN CITIES
- CHARGING MOTORISTS FOR USING THE ROADS
- IMPROVE PUBLIC TRANSIT, WALKING AND CYCLING FACILITIES

(Institution for Transportation and Development Policy)

KYOTO PROTOCOL:

- GIVE INCENTIVES \$\$\$ TO COUNTRIES THAT HAVE FEWER CARS AND BETTER PUBLIC TRANSPORTATION
- GIVE PENALTIES FOR COUNTRIES THAT HAVE POOR PUBLIC TRANSPORTATION

LOCAL

IN ST. LOUIS—DEVELOP IMPROVED PUBLIC TRANSPORTATION



http://upload.wikimedia.org/wikipedia/commons/5/56/MetroBus_and_St_Louis_Gateway_Arch.jpg

20-40 PERCENT REDUCTION OF DRIVING IN AREAS OF COMPACT DEVELOPMENT
 (U.S. Department of Transportation)



FAMILY

AS AN INDIVIDUAL:

- DRIVE LESS —
- CARPOOL MORE
- USE PUBLIC TRANSPORTATION
- KEEP CAR IN GOOD CONDITION
- BUY MORE FUEL EFFICIENT CARS

(The Green Gate — NRD's Environmental Guide to the San Francisco Bay Area)



(Photo credit: Megan Schutte)



(Photo credit: Megan Schutte)



Are your burger and fries causing climate change?



Replacement of natural habitats with cropland and grazing areas
By Katie Fischer and Allison Prost

Habitat Destruction

Alteration of a natural habitat to the point that it is rendered unfit to support the species dependent upon it as their home territory. (Encyclopedia of Earth)

Habitats Replaced for Cropland

Around 50% of the world's habitable land has been converted to farm land. (WWF)



Photo taken by Katie Fischer

Agriculture = main cause of habitat loss which threatens entire ecosystems and many species. (WWF and Encyclopedia of Earth)

It's predicted that by 2050 in developing countries 120 million more hectares of natural habitats will be converted into farmland to meet food demands. (WWF)



Photo by Katie Fischer

- ~ Forests = one of main habitats destroyed for agriculture land use
- ~ If the trees are burned/left to rot, stored carbon is released
- ~ When cut, CO₂ absorption stops
- ~ Agricultural crops draw in CO₂, but forests store up to 100 times more than agricultural fields of the same area

~ CO₂ = greenhouse gas, contributes to climate change — replacing habitats for cropland releases CO₂ & decreases absorption of CO₂ (Weather & Climate and WWF)

Sources of Greenhouse Gas Emissions

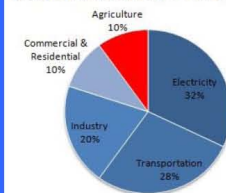


Chart created by Katie Fischer, information from EPA



Greenhouse Gas Emissions from Agriculture, 2012

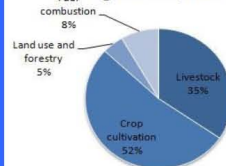


Chart created by Katie Fischer, information from EPA

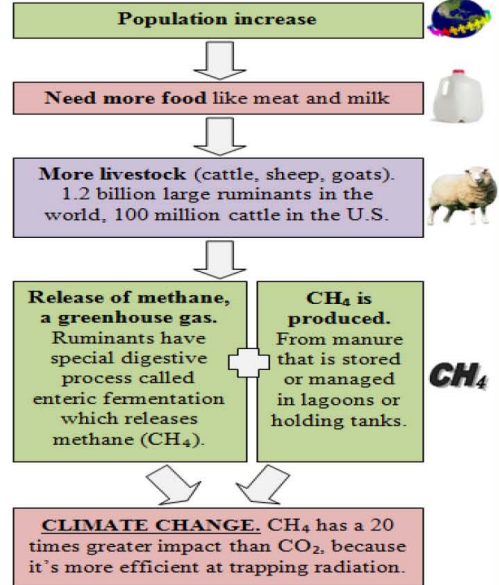
- ~ Fossil fuels—power machinery, used for manufacturing fertilizers and agricultural chemicals
- ~ Petroleum-based chemicals-create artificial soil fertility, protect against pests, and prevent weeds.

~ Farming equipment adds to greenhouse gas emissions. (GRACE)

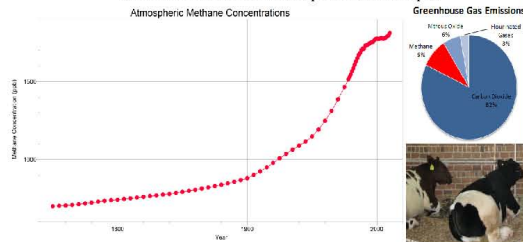


Wikimedia

Habitats Replaced for Grazing Areas



Above information from EPA, pictures from Clipart



Graph, Chart, and Photo by Katie Fischer. Graph information from EEA, Chart information from EPA

- ~ Globally, agriculture sector = primary source of CH₄ emissions, ruminants being one of largest methane sources
- ~ Livestock production emits other greenhouse gases like nitrous oxide and carbon dioxide (EPA)

What can we do?

Globally ~ The Global Restoration Network—project that offers options for restoration (GRN)

~ Extend the Kyoto Protocol to protect natural habitats or pass international laws that would help stop habitat destruction

Locally ~ Support programs like Bring Conservation Home (St. Louis Audubon Society)

~ Pass state/local laws-protect habitats, reduce climate change

Individually ~ Plant more trees/plants

~ Eat less meat/dairy

~ Eat local & choose sustainably raised foods (GRACE)



