Island of Gaea (Mother Earth)
Unit Plan

August 1st 2008
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Science 9
9th Grade Earth/Space Science

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This second unit plan during the summer 2008 at MTU is dedicated to my daughter Sydney. She has given up so much of her time with her mom this summer so that I may take classes to make sure both of our lives are enriched through learning. I love you very much.

Mom

Future Fuels from Forests Teacher Institute
Michigan Technological University

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Unit Plan

I. Unit Overview:

What is the source of all energy? One could answer…The Sun!

In looking at the sun as the source of all energy, the intriguing chemical process of photosynthesis in plants has made life possible on earth as we know it today. Man and scientists alike have culminated together to seek its astonishing resources on many facets throughout history.

Today's generation is being face with a new challenge. With fossil fuels being "quickly" depleted as far as the geological time scale reference is concerned, an alternative must be found. Alternative energy made from biomass (plant and animal) is part of the answer. Bioenergy which needs to be studied, engineered and produced for biofuels must be done so with utmost car to guarantee its use in future generations. In creating these new fuels from the forests, productivity along with sustainability must be considered when harvesting to ensure biodiversity and longevity of the resource used.

This unit was created in efforts to correlate the Michigan High School Content

Expectations with classroom instruction on alternative energy forms of renewable resources.

II. Sources Consulted:

Sources for this unit plan were derived from the various presentations, lectures, field studies, shared ideas and readings from the Future Fuels from Forests Teacher Institute July 7th through July 11th 2008 at Michigan Technological University. Individual lesson plan resources and references that were consulted are listed at the end of each lesson in the unit.

III. Learning Objectives:

- Students will be able to understand the difference between renewable and non-renewable resources.
- Students will acquire new vocabulary.
- Students, working in groups, will research biofuels, bioenergy and sustainability.
- Students will be responsible for taking a position in a debate and defend the position.
- Students will be able to produce graphs (line, bar and pie) on Excel.
- Students will be able to interpret, analyze and make inferences on graphs and data presented in readings and from the graphs they derive.

IV. State and/or National Objectives:

State and/or National objectives for this unit are listed below:

- **E1.1 Scientific Inquiry** Science is a way of understanding nature. Scientific research may begin by generating new scientific questions that can be answered through replicable scientific investigations that are logically developed and conducted systematically. Scientific conclusions and explanations result from careful analysis of empirical evidence and the use of logical reasoning. Some questions in science are addressed through indirect rather than direct observation, evaluating the consistency of new evidence with results predicted by models of natural processes. Results from investigations are communicated in reports that are scrutinized through a peer review process.

- **E1.1A** Generate new questions that can be investigated in the laboratory or field.
- **E1.1B** Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions.
- **E1.1C** Conduct scientific investigations using appropriate tools and techniques (e.g., selecting an instrument that measures the desired quantity—length, volume, weight, time interval, temperature—with the appropriate level of precision).
- **E1.1D** Identify patterns in data and relate them to theoretical models.
- **E1.1E** Describe a reason for a given conclusion using evidence from an investigation
- **E1.2 Scientific Reflection and Social Implications**

  The integrity of the scientific process depends on scientists and citizens understanding and respecting the "Nature of Science." Openness to new ideas, skepticism, and honesty are attributes required for good scientific practice. Scientists must use logical reasoning during investigation design, analysis, conclusion, and communication. Science can produce critical insights on societal problems from a personal and local scale to a global scale. Science both aids in the development of technology and provides tools for assessing the costs, risks, and benefits of technological systems. Scientific conclusions and arguments play a role in personal choice and public policy decisions. New technology and scientific discoveries have had a major influence in shaping human history. Science and technology continue to offer diverse and significant career opportunities.
- **E1.2A** Critique whether or not specific questions can be answered through scientific investigations.
- **E1.2B** Identify and critique arguments about personal or societal issues based on scientific evidence.
- **E1.2C** Develop an understanding of a scientific concept by accessing information from multiple sources. Evaluate the scientific accuracy and significance of the information.
- **E1.2D** Evaluate scientific explanations in a peer review process or discussion format.
- **E2.2 Energy in Earth Systems**

  Energy in Earth systems can exist in a number of forms (e.g., thermal energy as heat in the Earth, chemical energy stored as fossil fuels, mechanical energy as delivered by tides) and can be transformed from one state to another and move from one reservoir to another. Movement of matter and its component elements, through and between Earth's systems, is driven by Earth's internal (radioactive decay and gravity) and external (Sun as primary) sources of energy. Thermal energy is transferred by radiation, convection, and conduction. Fossil fuels are derived from plants and animals of the past, are nonrenewable and, therefore, are limited in availability. All sources of energy for human consumption (e.g., solar, wind, nuclear, ethanol, hydrogen, geothermal, hydroelectric) have advantages and disadvantages.

- **E2.2B** Identify differences in the origin and use of renewable (e.g., solar, wind, water, biomass) and nonrenewable (e.g., fossil fuels, nuclear [U-235]) sources of energy.
- **E2.3 Biogeochemical Cycles**

  The Earth is a system containing essentially a fixed amount of each stable chemical atom or element. Most elements can exist in several different states and chemical forms; they move within and between the geosphere, atmosphere, hydrosphere, and biosphere as part of the Earth system. The movements can be slow or rapid. Elements and compounds have significant impacts on the biosphere and have important impacts on human health.
- **E2.3A** Explain how carbon exists in different forms such as limestone (rock), carbon dioxide (gas), carbonic acid (water), and animals (life) within Earth systems and how those forms can be beneficial or harmful to humans.
- **E2.3d** Explain how carbon moves through the Earth system (including the geosphere) and how it may benefit (e.g., improve soils for agriculture) or harm (e.g., act as a pollutant) society.
- **E2.4 Resources and Human Impacts on Earth Systems**

  The Earth provides resources (including minerals) that are used to sustain human affairs. The supply of non-renewable natural resources is limited and their extraction and use can release elements and compounds into Earth systems. They affect air and water quality, ecosystems, landscapes, and may have effects on long-term climate. Plans for land use and long-term development must include an understanding of the interactions between Earth systems and human activities.
- **E2.4A** Describe renewable and nonrenewable sources of energy for human consumption (electricity, fuels), compare their effects on the environment, and include overall costs and benefits.

- **E2.4B** Explain how the impact of human activities on the environment (e.g., deforestation, air pollution, coral reef destruction) can be understood through the analysis of interactions between the four Earth systems.
- **E5.4 Climate Change**
  Atmospheric gases trap solar energy that has been reradiated from the Earth's surface (the greenhouse effect). The Earth's climate has changed both gradually and catastrophically over geological and historical time frames due to complex interactions between many natural variables and events. The concentration of greenhouse gases (especially carbon dioxide) has increased due to human industrialization which has contributed to a rise in average global atmospheric temperatures and changes in the biosphere, atmosphere, and hydrosphere. Climates of the past are researched, usually using indirect indicators, to better understand and predict climate change.
- **E5.4C** Analyze the empirical relationship between the emissions of carbon dioxide, atmospheric carbon dioxide levels and the average global temperature over the past 150 years.

English and Language Arts High School Content Expectations

- **STANDARD 2.1** Develop critical reading, listening, and viewing strategies.
- **CE 2.1.1** Use a variety of pre-reading and previewing strategies (e.g., acknowledge own prior knowledge, make connections, generate questions, make predictions, scan a text for a particular purpose or audience, analyze text structure and features) to make conscious choices about how to approach the reading based on purpose, genre, level of difficulty, text demands and features.
- **CE 2.1.2** Make supported inferences and draw conclusions based on informational print and multimedia features (e.g., prefaces, appendices, marginal notes, illustrations, bibliographies, author's pages, footnotes, diagrams, tables, charts, maps, timelines, graphs, and other visual and special effects) and explain how authors and speakers use them to infer the organization of text and enhance understanding, convey meaning, and inspire or mislead audiences.
- **CE 2.1.3** Determine the meaning of unfamiliar words, specialized vocabulary, figurative language, idiomatic expressions, and technical meanings of terms through context clues, word roots and affixes, and the use of appropriate resource materials such as print and electronic dictionaries.

- **CE 2.3.5** Engage in self-assessment as a reader, listener, and viewer, while monitoring comprehension and using a variety of strategies to overcome difficulties when constructing and conveying meaning.
- **CE 2.3.6** Reflect on personal understanding of reading, listening, and viewing; set personal learning goals; and take responsibility for personal growth.

Teaching/Learning Styles Employed

A. Multiple Intelligences
    a. Verbal/Linguistic Intelligence
        i. Learning new vocabulary
        ii. Completing Graphic Organizers and Charts
    b. Naturalist Intelligence
        i. Communion with nature
    c. Visual/Spatial Intelligence
        i. Forming mental images
        ii. Graphic representation
        iii. Interpreting Visual Images
    d. Interpersonal Intelligence
        i. Verbal and Nonverbal communication
        ii. Working cooperatively in a group
    e. Logical/Mathematical Intelligence
        i. Discerning relationships and connections
        ii. Scientific reasoning
        iii. Understanding the order and meaning of words
        iv. Memory and recall

B. Learning Styles (visual, auditory, kinesthetic/tactile)

a. Visual

b. Auditory

V. Ten Days of Classroom Activities

Island of Gaea's Dilemma Daily Schedule at a Glance

Day 1 Power Point Presentation on Renewable and Non-Renewable Resources

Day 2 Introduction to Excel Graphing (M&M Graphing Worksheet)

Day 3 Excel Graphing with Fuels and Energy Data

Day 4 Introduction to Island of Gaea's Dilemma and Group Assignments

Day 5 through Day 8 Library Research and Town Council Meeting Preparation

Day 9 Biomassatopia's Town Council Meeting

Day 10 Extra Day if needed for Biomassatopia's Town Council Meeting

Teacher Background Information:

- Basic Bioenergy Information- from Maria Janowiak, Northern Institute for Applied Carbon Science

  http://nrs.fs.fed.us/niacs/opportunities/bioenergy/ as viewed on July 20th 2008
  http://www.aboutbioenergy.info/ as viewed on July 20th 2008
  http://biomass.forestencyclopedia.net/ as viewed on July 20th 2008

- Environmental Considerations-from Dr. David Flaspohler and Dr. Chris Webster
  Flaspohler, David, Chris Webster, and Robert Froese. *In press*. Ch. 7 Bioenergy, Biomass and Biodiversity. In: Renewable Energy from Forest Resources in the U.S.; Solomon, B.D. and V. A. Luzadis, eds., Routledge.

- Environmental Considerations- Dr. David Flaspohler and Dr. Chris Webster Fargione, Joseph, et al. (2008). Land Clearing and the Biofuel Carbon Debt. www.scienceexpress.org

Day 1

I. Title of Lesson: Renewable and Non-renewable Resources Power Point

Length of Lesson: One 45-minute class period

Grade Level: 9th Grade-Science 9 or Biology

II. Introduction:

Statement of problem:

- The Big Question of this Unit: What are the consequences of clear-cutting a forest to plant genetically altered aspen trees next to a wetland preserve?
- What are renewable and non-renewable resources?

III. High School Content Expectations:

Earth Science High School Content Expectations are listing in the unit plan objectives for his particular lesson.

IV. Lesson Objectives:

Content Objectives-students will:

- Students will describe renewable and non-renewable resources and list examples of each.
- Students will be able to analyze data on charts and graphs and give interpretation of the data.
- Students will be able to discuss the recent changes alternative energy forms used for fuel.
- Students will be able to identify what biomass is and how much we have available for ethanol production.

Literacy Objectives-students will:

- Read for information.
- Acquire new vocabulary.
- Synthesize information from the text.
- Make inferences from the text including from charts and graphs.

V. Materials Needed:

- Power Point Projector
- Computer
- Notebook
- Pencil

VI. Safety Concerns:

There is no safety concern associated with this assignment that the instructor needs to be aware of at this time.

VII. Instructional Input:

Students will participate in taking notes and teacher-led discussion during the power point presentation presented by the instructor. A copy of the power point to be used is also attached in the appendix of the unit plan. (**Power Point Presentation for Island of Gaea-Renewable and Non-Renewable Resources**)

VIII. References:

- Dobson, K., Holman, J. and Roberts, M. Holt Science Spectrum: *A Physical Approach.* (2001) New York: Holt, Rinehardt and Winston

- Ideas and slides reproduced from the following presentations:

  Shonnard, David R. Power Point Presentation: Overview of Energy and Future Fuels: Assessing Social, Economic and Environmental Considerations of Energy (July 7-11th 2008) Michigan Technological University Future Fuels from Forests Summer Institute (Slides used from original power point presentation)

  Flaspohler , D. and Webster C. Power Point Presentation: Biodiversity and productivity in plant communities used for ethanol feedstocks. (July 7-11th 2008) Michigan Technological University Future Fuels from Forests Summer Institute (Slides used from original power point presentation)

- Graphics, clipart and pictures are referenced under each item within the power point presentation.

Day 2 through Day 3

I. Title of Lesson: Graphing with Excel (M&M Graphing and Graphing with Fuels and Energy)

Length of Lesson: Three 45-minute class periods

Grade Level: 9th Grade-Science 9 or Biology

II. Introduction:

Statement of problem:

- The Big Question of this Unit: What are the consequences of clear-cutting a forest to plant genetically altered aspen trees next to a wetland preserve?

Intended outcomes:

- Students will be able to graph data from a table and interpret results.
- Students will learn the renewable and non-renewable resources available for fuels.

III. High School Content Expectations:

Earth Science High School Content Expectations are listing in the unit plan objectives for this particular lesson.

IV. Lesson Objectives:

Content Objectives-students will:

- Students will be able to graph data from a table to excel creating a line, bar or pie graph with data interpretation.

Literacy Objectives-students will:

- Read for information.
- Read to perform a task.
- Read to develop fluency.
- Acquire new vocabulary.
- Synthesize information from the text.
- Make inferences from the text.

V. Materials Needed:

- Handout on Excel Graphing with M&M's (see Appendix for copy of PDF)

- Computer
- Pencil
- Handout with Data on Fuels and Energy Data (see Appendix for copy of PDF)

VI. Safety Concerns:

There is no safety concern associated with this computer lab that the instructor needs to be aware of at this time.

VII. Instructional Input:

Introduction to Excel Graphing (M&M Graphing Worksheet):
There is little instructional input to this computer lab. Students will be electronically sent a copy of the assignment through gaggle.net, the schools intranet service. Students will complete the task clearly described in the assignment. The instructor is walk around helping those students indirectly by pointing out areas on the pull down menus that will assist them in completing the assignment correctly.

Excel Graphing with Fuels and Energy Data:
After students have completed the M &M graphing assignment they may work on graphing the following data tables. A copy of the data and assignment is also provided in the appendix of the unit plan.
Data tables were acquired from the following websites for Excel graphing activity.

http://www.earth-policy.org/Indicators/CO2/2008_data.htm

http://www.earth-policy.org/Indicators/CO2/2008_data3.htm

http://www.earth-policy.org/Indicators/CO2/2008_data.htm#table4

VIII. References:

Data tables acquired from the following websites for Excel graphing activity.

http://www.earth-policy.org/Indicators/CO2/2008_data.htm on July 12th 2008.

http://www.earth-policy.org/Indicators/CO2/2008_data3.htm on July 12th 2008.

http://www.earth-policy.org/Indicators/CO2/2008_data.htm#table4 on July 12th 2008.

M&M Graphing with Excel adapted and accessed from PDF Files http://www.madison.k12.il.us/handouts/scott/excel/mms.pdf accessed on August 1st 2008.

Day 4 through Day 10

I. Title of Lesson: Island of Gaea's Dilemma

Length of Lesson: Five to Six 45 minutes class periods

Grade Level: 9th Grade-Science 9

II. Introduction:

Statement of problem:

- The Big Question of this Unit: What are the consequences of clear-cutting a forest to plant genetically altered aspen trees next to a wetland preserve?

Intended outcomes:

- Students will be able to understand the difference between renewable and non-renewable resources.
- Students will acquire new vocabulary.
- Students, working in groups, will research biofuels, bioenergy and sustainability.
- Students will be responsible for taking a position in a debate and defend the position.

III. High School Content Expectations:

Earth Science High School Content Expectations are listing in the unit plan objectives for this particular lesson.

IV. Lesson Objectives:

Content Objectives-Students will:

- Students will be able to understand the difference between renewable and non-renewable resources.
- Students will acquire new vocabulary.
- Students, working in groups, will research biofuels, bioenergy and sustainability.
- Students will be responsible for taking a position in a debate and defend the

position.

Literacy Objectives-Students will:

- Read for information.
- Read to perform a task.
- Read to develop fluency.
- Acquire new vocabulary.
- Synthesize information from the text.
- Make inferences from the text.

V. Materials Needed:

- Handout on the Island of Gaea's Dilemma
- Computer
- Poster Board
- Crayons, Colored Pencils and/or Markers
- Printer
- Pencil
- Textbook Holt Science Spectrum-The Physical Approach

VI. Safety Concerns:

There is no safety concern associated with this assignment that the instructor needs to be aware of at this time.

VII. Instructional Input:

On day four, the instructor will divide the class into five groups. A copy of the assignment will be handed out to the students. Island of Gaea's Dilemma The instructor will read over with the students the requirements of the assignment outlining the next five days of events that will take place. Students will have three to four days in the library to prepare their groups position. On the ninth day they will present the groups position at the town council meeting.

VIII. References:

Biodiversity of Species:

http://www.sciencemag.org/cgi/content/citation/312/5781/1745 viewed on July20th 2008.
http://www.agobservatory.org/library.cfm?refid=102584 viewed on July 20th 2008.
http://www.esa.org/pao/policyActivities/Sustainability%20of%20Cellulosic%20Biofuels%20handout%206.11.pdf viewed on July20th 2008.
http://www.sciencedaily.com/releases/2008/05/080527130056.htm viewed on July 20th 2008.

Biomass:

Basic Bioenergy Information- from Maria Janowiak, Northern Institute for Applied Carbon Science
http://nrs.fs.fed.us/niacs/opportunities/bioenergy/

http://www.aboutbioenergy.info/

http://biomass.forestencyclopedia.net/

Environmental Considerations:

Dr. David Flaspohler and Dr. Chris Webster
Fargione, Joseph, et al. (2008). Land Clearing and the Biofuel Carbon Debt. www.scienceexpress.org
Dr. David Flaspohler and Dr. Chris Webster
Searchinger, Timothy, et al. (2008). Use of U.S. Croplands for Biofuels Increases Greenhouse gases Through Emissions from Land use Change. www.scienceexpress.org

Dr. David Flaspohler and Dr. Chris Webster
Grunwald, Michael. *The Clean Energy Scam* in Time Magazine. March 27, 2008. (There are many links to other articles in Time from this article).

Cellulosic Ethanol:

From Dr. Barry Solomon Greer, Diane. (May, 2005). Creating Cellulosic Ethanol: Spinning Straw into Fuel.
Biocycle *eNews Bulletin.*
http://www.harvestcleanenergy.org/enews/enews_0505/enews_0505_Cellulosic_Ethanol.htm

Genetically Engineered Trees:

http://www.usatoday.com/tech/news/techinnovations/2003-07-31-gen-mod-trees_x.htm viewed on July 20th 2008.
http://www.sierraclub.org/biotech/trees.asp viewed on July 20th 2008.
http://www.forestry.oregonstate.edu/coops/tbgrc/publications/James_1998_Biomass_Bioenergy.pdf viewed on July 20th 2008.
http://www.grassrootsnetroots.org/articles/article_6435.cfm viewed on July 20th 2008.

Island of Gaea's Dilemma Project References:
Island of Gaea's Dilemma is based on the original idea of Sheryl Shea, shshea@ashland-city.k12.oh.us Ashland High School, Ashland, Ohio (Genetica's Dilemma).
http://projects.edtech.sandi.net/staffdev/tpss99/processguides/consensus.html

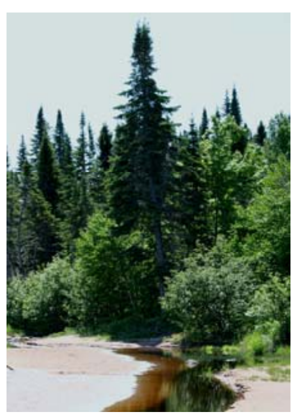
IX. Unit Assessment

Strategies for Promoting Student Inquiry:

- Strategies for promoting student inquiry are using graphic organizers for a visual picture and that of web quests for increasing the use of technology in the classroom. Students like the independent work that is on a web quest and they are excited to fulfill the 20 hour graduation requirement of an online experience in the classroom by using our intranet (gaggle.net).
- Students are excited about the topic at hand naturally because of the news exposure and the global concern of our planet Earth.

Assessment of Learning:

- Students will turn in the written summary of individual thoughts on the topic for assessment.-see Island of Gaea's Dilemma Handout for full evaluation requirements.
- Visual assessment of group discussion and interaction amongst students during the research and the debate.
- Observations of student's participation on the activity worksheets on excel graphing.



X. Appendix

A. Power Point Presentation for Island of Gaea-Renewable and Non-Renewable Resources

B. Graphing With Excel PDF Extension for M&M graphing Exercise with MS Excel

C. Graphing With Excel and Energy:

Name: ______________________________	**Date: __________________**	**Hr: _________**
Graphing With Excel Energy-Gaea's Dilemma		**Science 9**

Please complete the following assignments using Excel. Make sure you print a final copy and email me a copy as an attachment using your gaggle.net account. Make sure you make these graphs presentation quality including with color and pictures. Remember that when you use items from the web they must be referenced somewhere on your work.

Assignment #1

Graph the following data in a line graph.

Carbon Dioxide Emissions from Fossil Fuels Burning in Top Ten Countries, 2006		
Country	Emissions	Share of Global Total
	Million Tons of Carbon	Percent
United States	1,656	19.8
China	1,480	17.7
Russia	437	5.2
India	391	4.7
Japan	342	4.1
Germany	221	2.6
Canada	177	2.1
United Kingdom	171	2.0
South Korea	130	1.6
Mexico	123	1.5
All Other Countries	3,249	38.8
Global Total	**8,379**	**100.0**

Source: Compiled by Earth Policy Institute from G. Marland, T. A. Boden, and R. J. Andres, "Global, Regional, and National CO2 Emissions," **Trends: A Compendium of Data on Global Change** (Oak Ridge, TN: Carbon Dioxide Information Analysis Center, 2007); BP, **Statistical Review of World Energy** (London: 2007).

Assignment #2

Graph the following in a line graph.

Atmospheric Concentration of Carbon Dioxide, 1900-2007	
Year	Carbon Dioxide
	Parts Per Million by Volume
1900	295.55
1901	295.30
1902	295.05
1903	294.80
1904	295.85
1905	296.90
1906	297.48
1907	298.05
1908	298.63
1909	299.20
1910	299.42
1911	299.63
1912	299.85
1913	300.07
1914	300.28
1915	300.50
1916	300.68
1917	300.87
1918	301.05
1919	301.23
1920	301.42
1921	301.60
1922	302.25
1923	302.90
1924	303.55
1925	304.20
1926	304.85
1927	305.50
1928	305.64
1929	305.78
1930	305.91
1931	306.05
1932	306.19

1933	306.33
1934	306.46
1935	306.60
1936	306.76
1937	306.93
1938	307.09
1939	307.25
1940	307.41
1941	307.58
1942	307.74
1943	307.90
1944	308.38
1945	308.86
1946	309.34
1947	309.82
1948	310.30
1949	310.78
1950	311.26
1951	311.74
1952	312.22
1953	312.70
1954	313.22
1955	313.73
1956	314.25
1957	314.77
1958	315.33
1959	315.98
1960	316.91
1961	317.65
1962	318.45
1963	318.99
1964	318.68
1965	320.03
1966	321.37
1967	322.18
1968	323.05
1969	324.62
1970	325.68
1971	326.32
1972	327.46
1973	329.68

1974	330.17
1975	331.14
1976	332.06
1977	333.78
1978	335.40
1979	336.78
1980	338.70
1981	340.11
1982	340.89
1983	342.84
1984	344.10
1985	345.87
1986	347.19
1987	348.98
1988	351.45
1989	352.89
1990	354.16
1991	355.49
1992	356.27
1993	356.96
1994	358.63
1995	360.62
1996	362.37
1997	363.47
1998	366.50
1999	368.14
2000	369.41
2001	371.07
2002	373.16
2003	375.80
2004	377.55
2005	379.75
2006	381.85
2007	383.72

Source: Data from Mauna Loa by Scripps Institute of Oceanography, CDIAC, and NOAA/ESRL at www.esrl.noaa.gov/gmd/ccgg/trends, updated January 2008, with long term historical data compiled by Worldwatch Institute from Scripps, ORNL, and IPCC.

Assignment #3
Graph the following data table in a bar graph.

Carbon Dioxide Emissions from Land Use Change and Forestry in Top Ten Countries, 2000	
Country	Emissions
	Million Tons Carbon
Indonesia	699.0
Brazil	374.2
Malaysia	190.6
Myanmar	116.0
Democratic Republic of the Congo	86.5
Zambia	64.2
Nigeria	53.1
Peru	51.1
Papua New Guinea	39.8
Venezuela	39.3
World Total	**2,077.8**

Source: R.A. Houghton, "**Emissions (and Sinks) of Carbon from Land-Use Change**," Report to the World Resources Institute from the Woods Hole Research Center (Washington, DC: WRI, 2003).