

ESA 21: ENVIRONMENTAL SCIENCE EXERCISES

Biogeochemical Cycles: Analysis of Personal Emissions

The Carbon Cycle and Mankind

Introduction

During the last two weeks, we have been investigating how plant life affects the carbon cycle. In the first week of this module, we found that plants sequester large sums of carbon in themselves. They are able to do this since, on average, photosynthesis produces more sugar than what is need by the plant during its respiration phase. As long as the plant is alive, it will continue to take carbon dioxide out of the air. However, we also found that a plant will return all of that carbon dioxide back into the atmosphere after it dies if the wood is burned or allowed to decay.

In this week's lab, we are going to investigate what effect mankind has on the carbon cycle. In particular, we are going to estimate the amount of carbon dioxide that each one of us is responsible for emitting each year. This analysis is going to study only those day-to-day activities that emit carbon dioxide, and not look at the unique events that we have that also emit carbon dioxide (like bulldozing a forest and grinding up the trees).



Mulching trees

Our modern way of life relies heavily on the emission of carbon dioxide. When we think about this, we often limit ourselves to the use of automobiles and trucks and a few industrial processes. We understand that when we burn the gasoline in our engines, we are oxidizing the fuel and creating carbon dioxide. However, there are other activities in our life that also emit CO_2 , even though we do not see the oxidation. When we use electricity, we are also emitting carbon dioxide. The majority of the electricity created in the state of Georgia is derived from burning natural gas or coal. We also emit CO_2 when we heat and cool our homes, since this requires the use of electricity or the burning of natural gas, propane, heating oil, or wood. Even our creation of garbage releases carbon dioxide in the environment. If this garbage is put into a landfill, it decays and puts CO_2 back into the atmosphere. If it is recycled, energy of some form will be used to accomplish this, emitting CO_2 in the process.

Calculating Your Emissions of Carbon Dioxide

Overview

So how much carbon dioxide is emitted to the atmosphere through your daily activities? To answer this question, you will use an online *Personal Greenhouse Gas Calculator* developed by the U.S. Environmental Protection Agency (EPA). The calculator sums the carbon dioxide produced by your driving, electricity use, and waste disposal, and provides you with an estimate of your annual carbon dioxide emissions. The calculator then allows you to see how changes in your lifestyle could reduce your carbon dioxide emissions.

Before you begin

Americans tend to contribute a lot of carbon dioxide through driving, so it is therefore vitally important that you know your vehicle's gas mileage. To assist you, the US Department of Energy and EPA have created a web site that allows users to look up the gas mileage for any vehicle made from 1985 through the present. Your first step is to determine your vehicle's gas mileage from this site. After entering the year, make, and model of your vehicle, you will be provided with its city and highway gas mileage. For simplicity's sake, assume that half of the miles you drive are highway travel, and the other half are city/suburban travel. To obtain a single value for gas mileage, simply use the average of the city and highway mileages listed.

Fuel Economy Site: <http://www.fueleconomy.gov>

Tips

The use of the calculator is largely self-explanatory, so detailed directions will not be provided. A few comments, though:

- (1.) In the **Transportation** section, make sure you select the appropriate time frame (week or year) for your entered mileage.
- (2.) In the **Home Energy** section, enter the average of your summer and winter electric and gas bills.

Personal Impact Calculator:

<http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterToolsGHGCalculator.html>

Activity

Complete the *Personal Greenhouse Gas Calculator* and enter the appropriate information in the Activity sheet. The Activity sheet will ask you to enter and analyze values from this first run of the calculator, and then use the subsequent section of the calculator to investigate how you can reduce your carbon dioxide emissions. When you have completed the exercise, print out a copy of the calculator and attach it to the Activity sheet. Prior to printing, make sure the values in the **Your Current Emissions** section are your original values from the first run of the calculator.

A portion of the Activity asks you to consider the change from a conventional vehicle to a more efficient gasoline-powered "hybrid" vehicle. To learn more about such vehicles, visit the link below from the US Department of Energy's Office of Transportation Technologies.

Hybrid Vehicles: <http://www.ott.doe.gov/hev/>

As it currently stands, the U.S. has decided against signing the Kyoto Protocols (although we did sign a non-binding agreement in 1992 that said that we would lower greenhouse gas emissions). This decision by the Bush Administration has angered many countries, who see the absence of the US in this agreement effectively making it a worthless document.

ESA 21: Environmental Science Activities

Activity Sheet
Personal Impact Analysis

Name:

Professor:

Calculating your total emissions:

Enter the values from the calculator in the table below and calculate the percent of total emissions for each.

Category	Lbs. of CO ₂ per year	Percent of Total Emissions
Transportation		
Home Energy - Electricity		
Home Energy - Natural Gas		
Home Energy - Fuel Oil		
Waste - Non recycled trash		
Total Annual Emissions		

Analysis:

For each question below, fully explain your answer.

In what category were your emissions highest? Does this surprise you?

How did your household's overall emissions compare with the average of 60,000 lbs. per year?
Does the magnitude of your emissions surprise you?

Making Changes:

If your results are typical, your emissions from Transportation comprised a significant amount of your overall emissions. Let's see how a highly fuel efficient vehicle would affect your carbon dioxide contributions. A number of "hybrid" gasoline powered vehicles are currently available, and these vehicles get significantly higher mileage than conventional vehicles. One example is the 2002 Honda Insight, which has a combined (average of city and highway) fuel efficiency of 64 MPG. In the first part of the *What You Can Do to Reduce Emissions* section, enter the appropriate value to increase your current vehicle's mileage to 64 MPG (enter the difference between your current MPG and 64 MPG). Hit the Tab key to register the change, and list the resultant reductions below. You can obtain the New CO₂ emissions by subtracting the "lbs CO₂ avoided" from your previous total, or by scrolling down to the end of the calculator.

	Percent Reduction in CO ₂	New CO ₂ emissions
Switching to hybrid vehicle		

After seeing the carbon reductions and visiting the web site on hybrid vehicles (<http://www.ott.doe.gov/hev/>), would you be willing to seriously investigate buying such a vehicle? Explain why or why not.

Clear the preceding change in vehicle mileage by highlighting the value you entered, entering "0" in its place, and pressing the TAB key. Then proceed through the *What You Can Do to Reduce Emissions* section, and choose at least three options that you would be willing to embrace. If you need to enter values (more MPG, thermostat changes, etc.) make sure they are reasonable changes. List the three changes below and list the percent reductions in your total emissions that occurred as a result of each.

Change	Percent reduction in annual CO ₂ emissions

Seeing the reductions in emissions that occur as a result of these changes, would you be willing to immediately implement any of them? Explain why or why not.