Kingsborough Community College
BEH 82 & BIO 33, Fall 2013
Prof. M. Ortiz & Prof. K. Polizzotto

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Introduction & Learning Objectives

Your BEH 82 and BIO 33 courses have been designed as a linked curriculum, as part of the Integrative Studies program at KCC. Specifically these two classes form what is called a contextualized math learning community. In plain English, that means you'll be working on math skills in the context of biology, and that the same group of students is registered for both courses.

This will help you to improve your quantitative reasoning (math) skills while deepening your understanding of the material covered in the Biology course. At the completion of the semester, we expect you to be able to:

1. Apply the scientific method to investigate a scientific problem.
2. Identify the limitations imposed on science and scientists.
3. Identify and distinguish the unity and diversity of living organisms.
4. Analyze the mutual influences between science, technology, and society.
5. Demonstrate an awareness of the diversity and fragility of the earth's environments.
6. Appreciate the structure and function of your own bodies utilizing a representative vertebrate organism.
7. Apply quantitative skills to solving problems in biology.

Required Textbooks

1) *BioInquiry: Making Connections in Biology* by Pruitt, N.L. & Underwood, L.S. 3rd edition. John Wiley & Sons, 2006. ISBN 978-0-471-47321-3
2) *Biology 33:Introduction to Modern Concepts of Biology* (lab manual). Bluedoor LLC, 2013. ISBN 978-1-59984-563-0

You are also required to purchase a knee-length lab coat and wear it to every BIO 33 lab. Shoes that completely cover your toes are also required in the lab. You will not be permitted to remain in lab without these items.

Course Grades

BEH 82

Worksheets	40%
Quizzes	40%
Final exam	20%
Total	100%

BIO 33

Exams (3)	30%
Lab reports	25%
Lab quizzes	25%
Final exam	20%
Total	100%

Course Policies

These policies apply equally to BEH 82 and to BIO 33.

Attendance

It is very important to attend every class. If you must be absent, it is MUCH better to talk to the instructor BEFORE the absence if possible. If you miss a classroom meeting or lab session, please contact the appropriate instructor as soon as possible to find out what you missed. Make sure to get notes from a classmate. If you miss a lab, contact Prof. Polizzotto as soon as possible to find out whether you can make it up by attending another section. Please note that often it is not possible to make up a lab, so try not to miss any!

KCC policy states that students who are absent more than 15% of the class hours will be assigned a WU grade (Unofficial Withdrawal). For BEH 82, if you miss more than 3.6 hours or for BIO 33 if you miss more than 9 hours, you will receive a WU unless you have appropriate documentation for the absence, such as a doctor's note.

Midterm exams (BIO 33, 30%)

The midterm exams in BIO 33 will contain multiple choice and short essay questions based on the material listed in the learning objectives (see general syllabus). You should study the material in the power point presentations, in the textbook, and the material discussed in class. Exams will be given during the regularly scheduled class time (see schedule). There are no make-up exams if you are absent, unless you have appropriate documentation (such as a doctor's note). If you are late on the day of an exam, no extra time will be allowed. Any exam that you do not take will be counted as a zero.

Worksheets (BEH 82, 40%)

Worksheets will be completed each week in your BEH 82 class, and you will typically work with a small group of other students to complete them. They are to be handed in and the end of class, graded, and returned the following week.

Quizzes

Quizzes are given in BEH 82 in class, as well as in BIO 33 in lab. BIO 33 lab quizzes cover the exercises conducted in pervious labs. The material to study for each quiz will be announced in class and on Blackboard one week before the scheduled quiz (see schedule for dates). The lowest quiz score for BIO 33 will be dropped. BEH82 quizzes cover the material from class. The material to study for each BEH82 quiz will be announced in class before the scheduled quiz (see schedule for dates). The lowest quiz score for BEH82 will be dropped.

Lab reports (BIO 33, 25%)

Lab reports are completed as you work in lab each week and collected at the end of the lab. Graded reports are returned the following week. The reports are found in your lab manual at the end of each exercise.

Final exam (20%)

The final exam is cumulative (comprehensive). The format may be similar to the midterm, with multiple choice and short answer questions, or it may consist of diagrams to label and longer essays to write. We will discuss the exact format during the last week of class before the final exam, which is scheduled for the week of **December 9th – 16th**. We will announce the exact time and place of both BEH 82 and BIO 33 final exams as soon as they are scheduled by the college. If you miss the final, you will NOT automatically receive an incomplete (INC) in the course; you will simply receive a zero on the final and your course grade will be calculated accordingly. Incompletes are given only when documented circumstances beyond your control (such as the flu or a car accident) prevent you from taking the final.

Academic dishonesty

We uphold the KCC policy on academic honesty (see Student Handbook online). There are serious consequences for cheating on exams or plagiarizing someone else's work (i.e., turning in work that is copied from another source). If you are not sure what constitutes academic dishonesty, please check with either instructor.

Plagiarism is the use of others' words and/or ideas without clearly acknowledging their source. As students, you are learning about other people's ideas in your course texts, your instructors' lectures, in-class discussions, and when doing your own research. When you incorporate those words and ideas into your own work, it is of the utmost importance that you give credit where it is due. Plagiarism, intentional or unintentional, is considered academic dishonesty and all instances will be reported to the Academic Judiciary. To avoid plagiarism, you must give the original author credit whenever you use another person's ideas, opinions, drawings, or theories as well as any facts or any other pieces of information that are not common knowledge. Additionally, quotations of another person's actual spoken or written words, or a close paraphrasing of another person's spoken or written words, must also be referenced. Accurately citing all sources and putting direct quotations – of even a few key words – in quotation marks are required.

Civility

Kingsborough Community College is committed to the highest standards of academic and ethical integrity, acknowledging that respect for self and others is the foundation of educational excellence.

Civility in the classroom and respect for the opinions of others is very important in an academic environment. It is likely you will not agree with everything that is said or discussed in the classroom. Courteous behavior and responses are expected. Therefore, in this classroom, any acts of harassment, and/or discrimination based on matters of race, gender, sexual orientation, religion, and/or ability is not acceptable.

Whether we are students, faculty, or staff, we have a right to be in a safe environment, free of disturbance and civil in all aspects of human relations.

Week	Date	BEH 82 (Mon)	BIO 33 lecture (Wed)	BIO 33 lab (Thurs)
1	9/9-9/12	Metric System Measurement	Science & Society Characteristics of Life	Observations
2	9/16-9/19	Basic Statistics	Bioethics Principles of Evolution	Predators & Prey **QUIZ 1**
3	9/23-9/26	Radiometric Dating English-Math Translations **QUIZ 1**	Macroevolution Human Evolution	Diversity & Classification **QUIZ 2**
4	9/30-10/3	English-Metric Conversions Population Graphs	Population Ecology	Owl Pellet Dissection **QUIZ 3**
5	10/7-10/10	Trophic Levels and Energy Calculations Longitude and Latitude	**EXAM 1** Community Interactions	Marine Aquarium Visit
6	10/14-10/17	**MONDAY 10/14 IS COLUMBUS DAY: COLLEGE CLOSED**	Ecosystems Human Impact on Earth	Photosynthesis **QUIZ 4**
7	10/21-10/24	Graphing **QUIZ 2**	**EXAM 2** Cell Structure & Function	Microscope & Microecosystems
8	10/28-10/31	Magnification/Field of View/Size Micrometers	Cell Division & Mitosis	Cells & Reproduction **QUIZ 5**
9	11/4-11/7	Continuation of Week 7 Probability	Reproduction Meiosis	Vertebrate Digestive System **QUIZ 6**
10	11/11-11/14	Genotype/Phenotype Ratios Punnett Squares **QUIZ 3**	**EXAM 3** Principles of Inheritance	Vertebrate Respiratory & Circulatory Systems
11	11/18-11/21	Probability of Mutations	Human Genetics Molecular Basis of Genetics	Vertebrate Urinary & Reproductive Systems
12	11/25	Percent of Eggs Fertilized Diploid vs. Haploid Division of Chromosomes in Meiosis	**WED 11/27 IS A FRIDAY SCHEDULE: NO BIO 33 CLASS**	NO CLASSES
13	12/2-12/5	Evolutionary Change Graphs Allele Frequency Calculations Geometric Progression **QUIZ 4**	Genetic Influence on Evolution Microevolution	**TUESDAY 12/3 IS A THURSDAY SCHEDULE: BIO 33 LAB** Reproduction & Fertilization **NO CLASSES THURSDAY 12/5: READING DAY**
FINAL EXAMS WEEK OF DEC 9th – 16th				

P/G Quiz

Take-home/Bb exam
Th 12/5 - F 12/6 48hrs.
(12am) - (11:59pm)

BEH 82 & BIO 33 Joint Assignment
Profs. Ortiz & Polizzotto, Fall 2013

For this assignment, you will estimate your personal impact on the ecosystem by calculating your individual carbon footprint. This document will provide background information needed for the assignment, and will guide you through the calculations. Along the way, you will be asked to answer several questions that will require you to combine your math skills with your knowledge of biology.

What is a carbon footprint?

A **carbon footprint** is a measurement of the amount of carbon dioxide added to the atmosphere each year. It is usually measured by estimating the emissions produced by your level of activity in five categories:

- Home energy use (electricity, natural gas, & fuel oil)
- Transportation (mass transit, car travel, & air travel)
- Food and diet (organically produced vs. traditionally produced)
- Consumer items (furniture, clothes, electronics, etc.)
- Recycling and waste

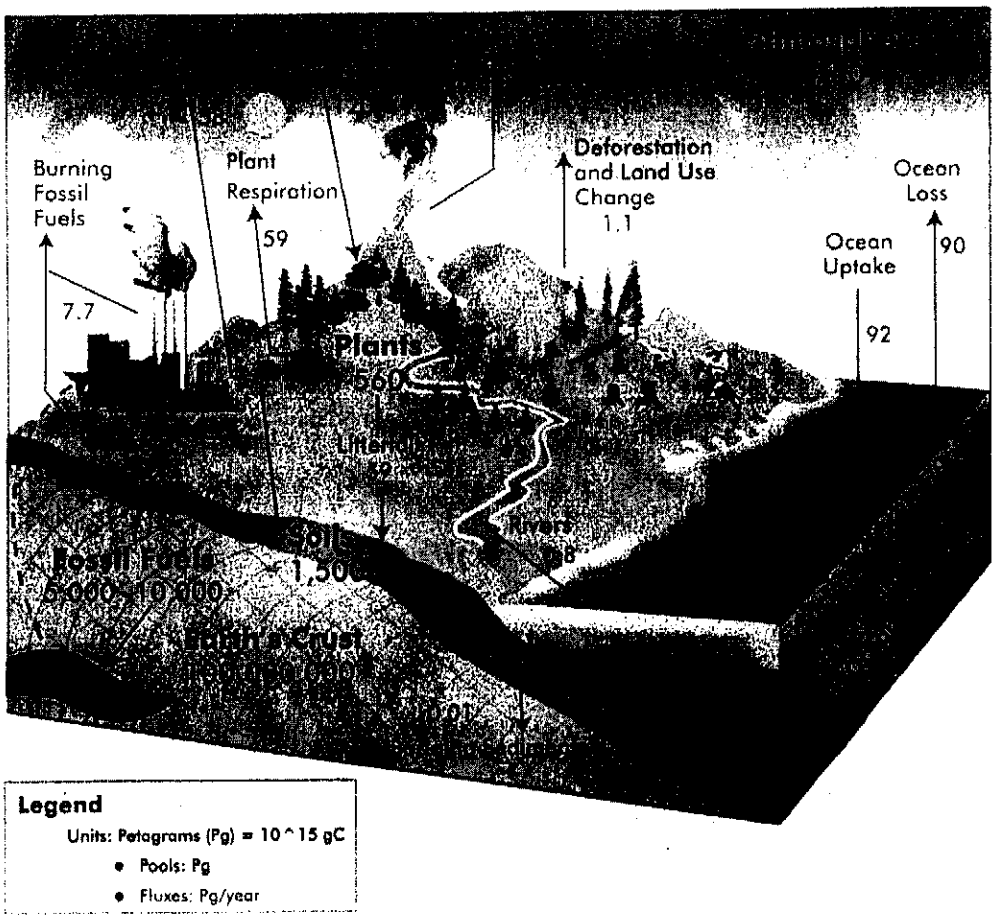
Emissions include all gases that are released into the atmosphere as waste products from burning fuel or other human activities, but since carbon dioxide is the most abundant emission (~80% of total greenhouse gas emissions), this is the gas most people focus on when considering the environmental impact of their lifestyle.

The carbon cycle

Recall our brief discussion of **biogeochemical cycles** in BIO 33 earlier this semester. Carbon is an element present in the earth, the atmosphere, the water, and the living organisms of the planet, and it cycles among these four **reservoirs** or **pools** constantly. As it cycles, it becomes incorporated into different molecules in the various reservoirs. For example, in living organisms carbon may take the form of glucose ($C_6H_{12}O_6$), while in the atmosphere it may take the form of carbon dioxide (CO_2). Photosynthesis is one process you learned about that converts carbon from CO_2 to $C_6H_{12}O_6$. Whenever carbon moves from one reservoir to another, this movement is called a **carbon flux**. Turn to the next page and examine the diagram of the carbon cycle. For now, ignore the numbers and pay attention to the words and the arrows. Notice that the blue font represents carbon pools, and the red arrows indicate carbon flux. In the space below, list the seven pools and the eleven fluxes.

Pool or reservoir	Flux
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.
	8.
	9.
	10.
	11.

Global Carbon Cycle



Data Sources: Adapted from Houghton R.A. Balancing the Global Carbon Budget. Annu. Rev. Earth Planet. Sci. 007 35:313-347, updated emissions values are from the Global Carbon Project: Carbon Budget 2009.

Where is most of the carbon on earth stored?

To answer this question, examine the diagram of the carbon cycle again, this time focusing on the numbers. As indicated in the diagram legend, these numbers represent petagrams (Pg) of carbon. From the information in the legend, how many grams are in one petagram?

1 Pg = _____ g

Based on your knowledge of the metric system and the conversion factor above, complete the following conversions. Show your work in the space to the right of each conversion. Write your answers using scientific notation.

1 Pg = _____ kg

500,000 kg = _____ Pg
Write the following sentence as a mathematical equation:

One megagram equals one thousand kilograms.

A megagram (Mg) is a metric ton (also written tonne). A standard (US) ton (also called a short ton) equals 2,000 pounds. How does a metric ton compare to a US ton? One metric ton (t) equals 1.1023 US tons (US t). Given that conversion factor, complete the following conversions. Show your work to the side.

5 t = _____ US t

7 US t = _____ t

Now refer back to the diagram of the carbon cycle. In the space below, do the following:

1) **Sum** the petagrams of carbon found in all the reservoirs.

2) Write down the three largest carbon reservoirs, and **sum** them.

3) Calculate the **percentage** of the total carbon on earth that is contained in the three largest reservoirs.

4) Write down the four smaller carbon reservoirs and sum them. Then calculate the percentage of total carbon on earth that is contained in the smaller reservoirs.

How do humans affect the carbon cycle?

One more piece of information is important for understanding the impact that humans have on the carbon cycle, and that is the amount of time an atom of carbon stays in one reservoir before cycling to another. This time period is called the **residence time**. What hypothesis can you make about the natural residence time of carbon in each of the seven reservoirs, without human influence?

Which reservoir has been the most disturbed by humans? In other words, in which reservoir have humans most significantly altered the residence time? (By the way nearly 95% of CO_2 emissions in the United States come from this reservoir.)

When humans remove carbon from this source and convert it to another form (usually CO_2), which reservoir does it go into? What is the residence time of the destination reservoir compared to the source reservoir?

Based on your calculations and your answers to the three questions above, can you now explain the negative impact of humans on the carbon cycle?

Can you explain why planting trees is one good way to offset these negative impacts? (Hint: look for one flux in which plants remove carbon from the reservoir where humans are dumping it in large quantities.)

Calculating your carbon footprint

By now you have realized that each human adds a certain amount of carbon dioxide to the atmosphere either directly or indirectly (see list below). Can you add one or two more sources to each list?

Direct additions	Indirect additions
Cellular respiration	Using electricity, which is generated mostly by burning fossil fuels

Some aspects of your carbon footprint are a little more complicated, such as consuming food grown on deforested land. Can you propose an explanation of how this example would add carbon dioxide to the atmosphere?

Now let's begin your personal calculations. Recall from the first page of this document the five categories of carbon dioxide emissions. To simplify the calculations, we will focus on three of these: home energy use, transportation, and waste. You will use standard measurements (pounds, gallons, miles, etc.), since these will be easier to estimate, and then at the end we will convert the final answer from US tons to metric tons.

The basic formula is as follows:

1) Estimate your annual use in each category.
2) Multiply annual use by a **carbon emission factor**.
3) Add up the totals for each category to get your total carbon emissions.

An emission factor (**EF**) is a conversion factor that indicates how much carbon dioxide is released into the atmosphere for each particular activity. For example, to figure out how much carbon dioxide you add to the atmosphere by driving a car, you multiply the number of miles you drive by the amount of carbon dioxide emitted per mile. This amount per mile is the emission factor. In your worksheet, the emissions factors are already given in the formulas. They are average numbers for the US, taken from published sources such as the Environmental Protection Agency (EPA) or the Energy Information Administration (EIA).

For each category below, fill in the numbers that apply to you and complete the calculations. If a category does not apply to you, for example if you always take public transport and do not ever ride in a car, skip that category. If your home or apartment does not use natural gas as an energy source, skip that category or write in a zero for total emissions from natural gas use.

Home energy use

For this section, you will need copies of recent electric and natural gas bills, as well as fuel oil bills if your house uses oil for heat. If you can't find any bills, ask the person who pays the utilities in your house to give you an estimate of the monthly bill. If you are unable to find this information, please ask one of your instructors and we will give you typical numbers for a US household.

Write down the number of people that live in your house: _____
Now calculate each emission that applies to you below:

Electricity emissions = (average monthly electric bill / price per kWh) / # of people in the household x 1.37 lbs CO_2 per kWh x 12 months per year

Natural gas emissions = (average monthly gas bill / price per therm) / # of people in the household x 12.061 lbs CO_2 per therm x 12 months per year

Fuel oil emissions = (average monthly fuel bill / price per gallon) / # of people in the household x 22.28 lbs CO_2 per gallon x 12 months per year

Transportation

For this section, we have included only travel by car and by plane only. If you use mass transit such as busses and trains, of course carbon is emitted, but it is more complicated to calculate your personal share and so we have omitted mass transit emissions for simplicity. If you do not know the fuel efficiency of the car or cars you ride in, use an average fuel efficiency of 22 miles per gallon (mpg).

Vehicle emissions = (number of miles traveled in a car per week x 52 weeks per year) / (average fuel efficiency x 19.564 lbs CO_2 per gallon)

Air travel emissions

Since most fuel is used on take-off and landing, you must first record the number of flights you take in an average year, including each leg of the flight as a separate flight. For example, if you take a round-trip flight to Florida with one stop each way, that is 4 legs or 4 flights total. Also, the length of each flight is important. Use the following information to determine the correct emission factor per passenger for short, medium, and long flights (see table on next page):

Length of flight	Definition (miles)	Emissions factor (lbs CO_2 per mile)
Short	< 750	0.64
Medium	750 to 2500	0.44
Long	> 2500	0.39

In the table below, write down the number of flights you take in an average year. Remember that each leg of the journey counts as one flight. For each flight, determine whether is it short, medium or long and then write the approximate mileage of each flight. You may need to use a map or an online mapping program (such as Google maps) to estimate the mileage. Next record the appropriate emissions factor in each row, and then multiply the mileage by the EF to get the CO_2 emissions for each flight. When you are done, add up all the numbers in the last column to get total CO_2 emissions for air travel.

Length of flight	Mileage	Emissions factor	Mileage x emissions factor
Total air travel emissions =			

Waste

Finally, let's calculate the amount of CO_2 you add to the atmosphere through waste (garbage & recycling) each year. Before we do, do you know why your garbage adds carbon to the air? When trash goes to a landfill, it is gradually decomposed and produces methane gas (CH_4). Methane is also a greenhouse gas like CO_2, and the emissions factor in the equation below allows you to convert the total pounds of methane produced from your garbage to an equivalent amount of carbon dioxide.

As for recycling, it is better for the environment because it produces less greenhouse gases than garbage I a landfill, but it still takes energy to recycle and reuse waste, and that energy usually comes from burning fossil fuels. So, you will do separate calculations for garbage that goes to a landfill and for recycled waste. This time, see if you can figure out what the equations will be for each.

You will need the following information:

In the US, each person produces an average of 4.34 lbs of garbage each day. Of this, 2.88 lbs goes to a landfill and the rest is recycled.

For garbage that goes to a landfill, the emissions factor (EF) is 0.94 lbs CO_2 per pound of garbage. For recycled waste, the EF is 0.6236 lbs CO_2 per pound of recycled waste.

Based on these facts, in the space on the top of the next page write equations for calculating the total emissions for one person in one year. Be sure to write one equation for garbage going to a landfill, and a separate equation for recycled waste.

Total landfill emissions =

Total recycling emissions =

Total carbon footprint

To get your total carbon footprint, go back through the last few pages and add up the following calculated emissions: electricity, natural gas, fuel oil, vehicle (car) travel, air travel, landfill, and recycling. This total is your carbon footprint in pounds (lbs) per year.

Total carbon footprint (lbs/year) =

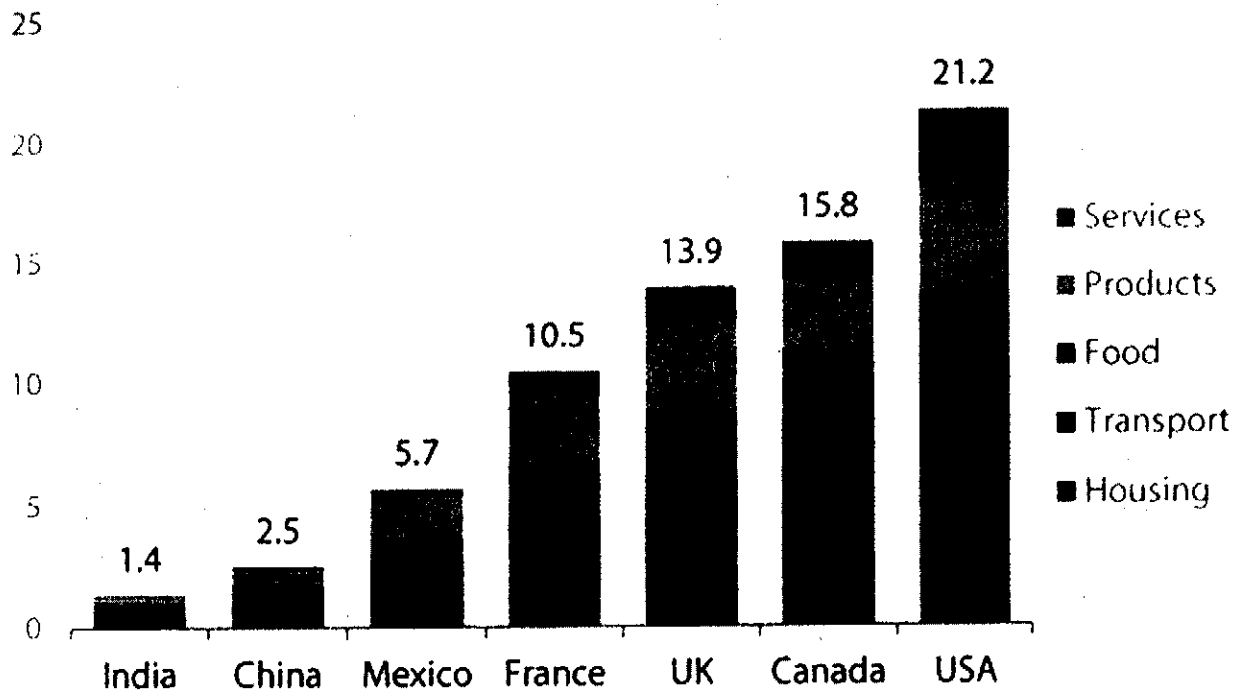
Convert this to US tons by dividing the total by 2,000 (because there are 2,000 lbs in a ton).

Total carbon footprint (US t/year) =

Finally, convert US tons to metric tons, using the conversion factor given earlier (1 metric ton = 1.023 US tons).

Total carbon footprint (t/year) =

Now, compare your average to the averages on the chart below. Most likely, your calculated average is much less than the average individual in the US as shown on the chart below. This is not necessarily because your footprint is actually less than average, however. Based on what you read in the chart, can your propose a hypothesis as to why your calculated average is lower than the average shown for the US?



Personal Carbon Footprints: t CO2e/capita (2004)

shrinkthatfootprint.com

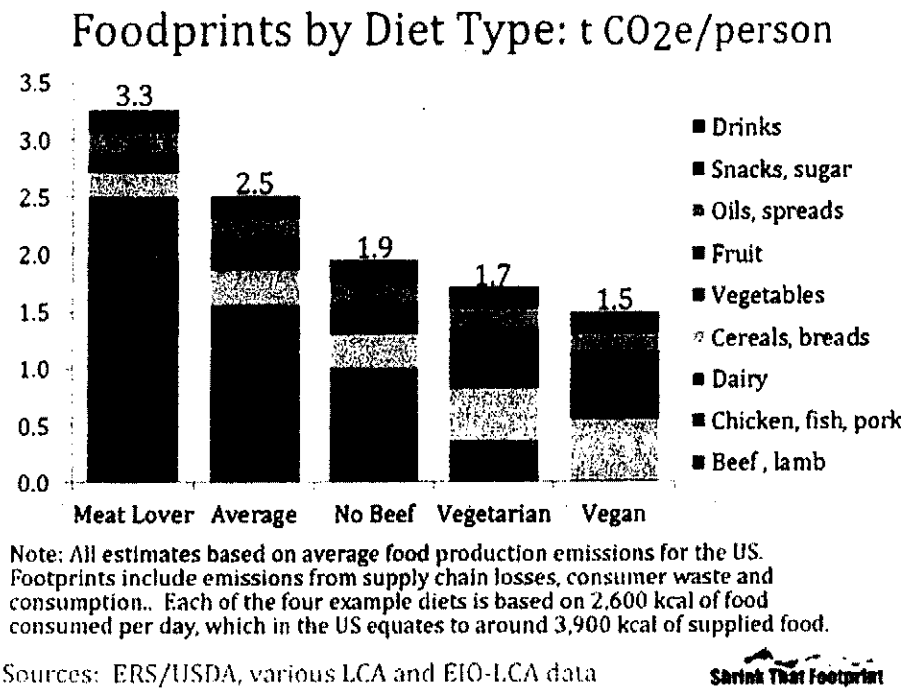
If you would like to see what your personal carbon footprint is taking into account additional sources of emissions (food, services, products), you can try one of the following online calculators to get a more accurate estimate of your impact.

http://www.nature.org/greenliving/carboncalculator/

http://www.carbonfootprint.com/calculator.aspx

http://shrinkthatfootprint.com/carbon-calculator

To conclude, at the bottom of this page write a paragraph describing realistic steps you could take to reduce your carbon footprint. Here is some additional information to get you started with a few ideas:



Turning down the thermostat in your house by one degree at night (while you're asleep) in the winter will save you approximately 1% off your utility bill. How much would your carbon footprint be reduced if you did this?

Replacing an older, inefficient refrigerator with an Energy Star model saves approximately 40 kWh of electricity per year. By how much could you reduce your annual carbon footprint if you replaced your old refrigerator?