



## Family Activity

GRADE LEVELS: 3-5, 6-8, 9-12

### CARBON FOOTPRINT: WHAT'S OURS? Vehicle Use on a Family Vacation

#### Introduction

Much is being said these days about the effect of human activity on global warming. Sound scientific evidence points to the role greenhouse gases play in this phenomenon. This activity is designed to encourage you and your family to explore the implications of your travel on the production of greenhouse gases and calculate the *carbon footprint* resulting from transportation to and from a family vacation destination.

*Carbon footprint* refers to the impact of carbon emissions on the environment in terms of greenhouse gases produced by humans. The carbon part of this phrase refers to the carbon dioxide (CO<sub>2</sub>) gas that humans leave behind anytime there is combustion or the burning of a fuel. Carbon dioxide is one of the main greenhouse gases that contribute to global warming and is produced (and left behind) every time we use standard gasoline-fueled vehicles.

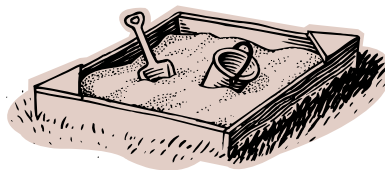
Depending on your child's grade level, you may wish to provide a bit more context regarding the concept of "footprints" (see the *Suggestions for Children in Grades 3-5* section below). Or you can skip ahead to the *Calculating Carbon Footprints* section on page 3.

#### Suggestions for Children in Grades 3-5

The connection between a footprint and environmental impact might not be readily apparent, especially to youngsters. So to lead into this activity for younger children, you might want to first conduct a mini-investigation of "footprints." For this, you will need a variety of balls from around the house and some sand, preferably lots of sand like a beach or a sandbox where your child can run, throw, and be very active.

With safety in mind, instruct your child to throw the balls down into the sand and look at the resulting marks left in the sand. Things he or she could change in this mini-investigation could include ball size, weight, throwing speed, or the angle at which the ball is thrown. You can also work with your child to change just one variable at a time. For example, using the same ball, try throwing it slowly at different angles to see what kind of mark is made in the sand. Or, with that same ball, keep the angle the same and try different throwing speeds. As marks are formed in the sand, talk with your child about the characteristics of these marks. Why do the marks appear the way they do? What connection, if any, can your child make between either the ball or the way it was thrown and the features of these marks? You want to encourage your child to think about cause and effect with probing questions like these. Use the chart that follows to facilitate this investigation.

## Making Marks in the Sand



Description of Ball (size/weight)	Throwing Speed (slow, medium, fast)	Angle of Throw	Characteristics of Mark

Follow this up by asking your child to make some marks in the sand using his or her feet, either with or without shoes on. As you did with the balls, discuss the variety of impressions or impacts left depending on the actions taken: walking, stomping, running, etc. At this point, you'll no doubt bring up the term

“footprint.” In your discussion, talk about a footprint as the visual impression or reminder of your child’s activity (ball throwing, walking, running) long after the activity has ended.

A footprint is tangible evidence that someone has passed by and had some sort of impact on the local environment. This is the image we want to convey when we use the term *carbon footprint*.

### Calculating Carbon Footprints

Not all footprints are the same; some are small, some can be quite large. The size of our impact on the environment due to burning *fossil fuels*—our carbon footprint—depends on how much carbon dioxide we produce when we burn these fuels. *Fossil fuels* are nonrenewable sources of energy such as coal, oil and natural gas. Many human endeavors produce carbon dioxide: transportation, manufacturing and industry, homes and commerce. The calculations you will make in this activity will focus just on transportation, namely the type of vehicle you use for a family vacation. Vehicle types might include a car, airplane, train, or bus.

There are many Web sites that provide information about how to calculate your carbon footprint for vehicular travel. Some of these can be found listed at the end of this activity; you are encouraged to visit and explore these Web sites. To simplify the calculations for this activity, a summary chart is presented below.

### **Carbon Dioxide Emissions Chart**

<b>Mode of Transportation/Vehicle</b>	<b>Emissions Factor (lbs. CO<sub>2</sub> per passenger mile)</b>
walking	0
bicycling	0
hybrid (46 mpg)	.11
average gasoline-powered car (23 mpg)	.22
bus	.18
train	.42
plane	.86

*Source: Planet Green, resource 1*

### Carbon Footprints from Family Vacations

Now it's time to calculate the carbon footprint resulting from vehicle usage for a family vacation. (Note: these calculations could also be applied to a short ride, a day of running errands, or some other type of vehicle usage.) For younger children, you may want to go through the exercise of "Estimating Carbon Footprints" on *Carbon Emissions Worksheet A*. For older children, you may wish to extend the exercise to "Calculating Actual Carbon Footprints" on *Carbon Emissions Worksheet B* and the "BONUS CHALLENGE!" on *Carbon Emissions Worksheet C*.

### **Directions**

#### **PART I**

Begin with *Carbon Emissions Worksheet A: Estimating Carbon Footprints* on page 8.

1. Choose a route or destination for a family vacation. Enter the "Starting Location" and "Ending Location" at the top of the worksheet.
2. Enter the distance of your trip in all the cells of the "Trip Distance" column so each vehicle type will travel the same distance. For the purposes of estimating your carbon footprint on this worksheet, assume mass transit takes you "door to door" and therefore you do not have to consider getting to and from mass transit hubs. If necessary, round the distances to make the calculations appropriate for your child.
3. Select the method of travel (vehicle) you plan to use for this family vacation and enter it into the first row in the chart ("Actual Vehicle Used").
4. Find the "Emissions Factor" for this vehicle (taken from the *Carbon Dioxide Emissions Chart*) and enter it in the second column. Multiply the "Emissions Factor" for the vehicle you have chosen by the "Trip Distance." This is the total lbs. of CO<sub>2</sub> produced per passenger or the "Carbon Footprint." Enter this number in the fourth column of the chart.
5. How would the carbon emissions differ if you used another form of transportation? Choose another vehicle from the *Carbon Dioxide Emissions Chart*, and using the associated "Emissions Factor," make a calculation similar to what you did in the previous step. Repeat for the other vehicle types, filling in the five remaining rows in the chart ("Other Vehicle Types").

6. Once you have filled in all rows, use the fifth column to rank the order of resulting "Carbon Footprints" from the smallest Carbon footprint (1) to the largest (5).

## ***PART II***

Go one step further and try to determine a more precise calculation of your carbon footprint. See *Carbon Emissions Worksheet B: Calculating Actual Carbon Footprints* on Page 9.

1. Choose a route or destination for a family vacation. Enter the "Starting Location" and "Ending Location" at the top of the worksheet.
2. For this exercise, you will want to factor in all modes of transportation used in traveling to and from the vacation destination. In the first row, enter the mode of transportation used for the first leg of the trip. (For example, one might use an average gasoline-powered car to get to the airport.)
3. Find the "Emissions Factor" for this vehicle (taken from the *Carbon Dioxide Emissions Chart*) and enter it in the second column.
4. Enter the total miles traveled for the first leg of the trip and enter this in the second column under "Trip Distance."
5. Multiply the "Emissions Factor" for the first method of travel you have chosen by the "Trip Distance." Enter this number in the "Carbon Footprint" column. This is the number of lbs. of CO<sub>2</sub> produced per passenger, or the "Carbon Footprint," for this leg of the trip.
6. In the next row, enter the subsequent mode of transportation used for the trip, if applicable. (For example, after arriving at the airport parking lot, one might use a bus to arrive at the terminal.) Enter this vehicle type in the first column of the chart.
7. Find the "Emissions Factor" for this vehicle (taken from the *Carbon Dioxide Emissions Chart*) and enter it in the second column.
8. Enter the total miles traveled for this leg of the trip in the second column under "Trip Distance."

9. Multiply the “Emissions Factor” for this mode of transportation by the “Trip Distance.” Enter this number in the “Carbon Footprint” column. This is the number of lbs. of CO<sub>2</sub> produced per passenger, or the “Carbon Footprint,” for this leg of the trip.

10. Repeat steps 6 through 9; incorporating all modes of transportation used in traveling from the Starting Location to the Ending Location.

11. Total all numbers in the “Carbon Footprint” column. This is a more precise calculation of the total amount of CO<sub>2</sub> produced per passenger on this trip.

### ***PART III – BONUS CHALLENGE!***

What other modes of transportation could be used to reduce the carbon footprint produced from this trip? Take the *Bonus Challenge* on Page 10. Is it possible to walk to the bus stop? Is it possible to use a hybrid taxi? Select alternative forms of transportation to see just how low the carbon footprint from this trip can go!

Repeat the directions in *Part II*, using different forms of transportation to compare the resulting carbon footprint to the actual CO<sub>2</sub> produced on this trip.

### ***Questions for Analysis***

How did the actual mode of transportation compare to the others? Why do you think some vehicles produce more carbon emissions than others? What is the energy source or fuel used by each vehicle? Even if some vehicles use the same type of fuel, why is the carbon footprint size different? Help guide your child in understanding the relationship between the type of fuel (especially fossil fuels) used, the amount of fuel or energy needed for a given vehicle type (i.e. larger vehicle, more fuel needed), and the resulting carbon footprint size.

### ***Offsetting Carbon Emissions***

Carbon offsets help reduce total worldwide greenhouse gases by funding projects that focus on renewable energy, energy efficiency, and reducing emissions in the short or long term. (*See resources 4 and 6 at the end of this activity for details.*) Use these resources to calculate the cost of offsetting the carbon dioxide produced by each type of vehicle you could have taken for your vacation. Enter these costs in the last column of each chart on *Worksheets A, B, and C*.

Purchasing carbon offsets does not reduce the actual carbon dioxide produced by a car or bus; it simply enables the conservation of energy (or the production of less polluting energy) elsewhere in the world.

This might present another topic of discussion with your child: How do the "costs" vary between vehicle types? Analyze the cost/benefit ratio. How do the costs compare among vehicle types? What is the benefit of using a particular vehicle type, even if the cost to offset it is high? How do you think carbon offsets help or hurt efforts to protect the environment?



**Carbon Emissions Worksheet A:  
Estimating Carbon Footprints**

**Trip Details:**

Starting Location: \_\_\_\_\_

Ending Location: \_\_\_\_\_

**Estimated Carbon Footprint:**

	<b>Mode of Transportation</b>	<b>Emissions Factor (see Chart A)</b>	<b>Trip Distance (miles)</b>	<b>Carbon Footprint</b>	<b>Rank</b>	<b>Offset cost</b>
Actual Vehicle Used						
Other Vehicle Types						

*This grid assumes mode of transportation is available and taken door-to-door.*



**Carbon Emissions Worksheet B:  
Calculating Actual Carbon Footprints**

**Trip Details:**

Starting Location: \_\_\_\_\_

Ending Location: \_\_\_\_\_

**Actual Carbon Footprint:**

Mode of Transportation	Emissions Factor (see Chart A)	Trip Distance (miles)	Carbon Footprint	Offset cost
<b>TOTAL:</b>				



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## Carbon Emissions Worksheet C: **BONUS CHALLENGE!**

### How Low Can Your Carbon Footprint Go?

What other modes of transportation could you feasibly take for the same trip to produce the smallest carbon footprint possible? Use the charts below to try multiple combinations.

#### Trip Details:

Starting Location: \_\_\_\_\_

Ending Location: \_\_\_\_\_

Mode of Transportation	Emissions Factor (see Chart A)	Trip Distance (miles)	Carbon Footprint	Offset cost
<b>TOTAL:</b>				

Mode of Transportation	Emissions Factor (see Chart A)	Trip Distance (miles)	Carbon Footprint	Offset cost
<b>TOTAL:</b>				

### What are the Implications of a Large Carbon Footprint?

Now that you've calculated the carbon emissions produced by your family vacation, help your child understand why the size of our "footprint" is important.

Leaving a carbon footprint behind means adding carbon dioxide gas to the atmosphere as a result of burning carbon-based fuels such as oil, coal, natural gas, and bio-fuels. Humans use a tremendous amount of these fuels in our everyday activities. Adding CO<sub>2</sub> to the atmosphere is like adding a blanket over the atmosphere. The result of this added insulation is a rise in the average air temperature of the earth, referred to as *global warming*.

Some of the concerns related to global warming include: glacial retreat and Arctic shrinkage, worldwide sea level rise, changes in crop yields, species extinctions, and changes in disease mechanisms, among others. Have your child consider how this could affect their future and the future of the planet. Current thinking says that if we can limit and even reduce the amount of CO<sub>2</sub> humans put into the atmosphere, we can limit the effect of global warming on the planet. The way to do this is to reduce our carbon footprint, in other words, try to minimize the amount of carbon dioxide we put into the air.

Ask your child to look back to the amount of carbon dioxide (the "carbon footprint") produced by the vacation travel from any type of vehicle. That's just one trip. Ask your child to think about how much carbon dioxide results from all vehicle use in a single year, even including trips to the grocery store, the park or a friend's house. You can work with your child to calculate the "carbon footprint" from multiple trips, or you might also ask your child to imagine that their entire class is going on a similar trip. Have your child calculate the total lbs. of CO<sub>2</sub> produced for all those passengers or for other types of transportation needs.

What kind of impact might this have on the environment? Does this affect how you would prefer to travel? If so, what would you do differently, if possible, in the future?

### In Closing

The next time you and your family have snow to play in, or on your next trip to the beach or local sandbox, be sure to make lots of footprints and tracks. Take the opportunity to think back to this activity and reflect on the alternate meaning of "footprint" that you helped develop with your child. It's likely the term "carbon footprint" will now have more meaning. The next time you and your family travel together, encourage your child to consider the carbon footprint he or she will be leaving behind.

## Resources

For more information, please visit the following Web sites:

1.

<http://planetgreen.discovery.com/tech-transport/plane-train-automobile-travel.html>

This Web site compares the emissions produced by four modes of travel: airplane, train, bus, and automobile.

2.

[http://www.carbonfund.org/site/pages/carbon\\_calculators/category/Assumptions](http://www.carbonfund.org/site/pages/carbon_calculators/category/Assumptions)

This is a helpful Web site to understand the various factors and assumptions that go into calculating carbon emissions for major sectors of energy use: transportation, residential, hospitality, business, and shipping.

3.

<http://science.howstuffworks.com/carbon-footprint.htm>

This Web site provides details explaining what a carbon footprint is and how it can be calculated. Numerous links are offered to resources about global warming, calculators for carbon footprints, and suggestions for reducing carbon emissions.

4.

<http://science.howstuffworks.com/carbon-offset.htm>

This Web site explains how carbon offsets work and discusses some of the issues related to offsets as well as links to resources offering offsets.

5.

<http://www.carbonfund.org/Calculators/>

This Web site provides a simple carbon footprint calculator that includes transportation and home activities.

6.

<http://www.carbonfund.org/projects>

This Web site provides links to carbon-offset projects in the areas of renewable energy, energy efficiency and reforestation.



For more resources, visit [www.FuelOurFutureNow.com](http://www.FuelOurFutureNow.com).  
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