

What is My Ecological Footprint? Activity

Design Notes

Grades: 9-12 General Education, Environmental Science

Next Generation Science Standards (NGSS):

- [HS ESS3-4](#) Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. (on individual level)
- [HS ESS3-5](#) Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems
 - [DCI ESS3.D: Global Climate Change](#) Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts.

Description

Students will determine their ecological (carbon) footprint, compare it to other students, and determine the impacts their lifestyle has on Earth and its resources. Students will also theorize what would happen if everyone on Earth lived the same ecological lifestyle. They will begin to understand the impacts an individual (or family) can have on the environment. Students will then think of ways they can lower their ecological footprint on personal and familial levels.

Time

- 2 50-minute class periods

Skills

- Graphing
- Calculating carbon footprint
- Making personal and social decisions based on perceptions of benefits and risks

Guiding Questions

- What is my personal impact on the planet?
- What impact does my family's lifestyle have on the planet?
- What steps can I take to reduce my impact on the planet and its resources?

Vocabulary

- **Carbon footprint** - measure of the total amount of carbon dioxide (CO₂) and methane (CH₄) emissions as a result of the activities of a particular individual, organization, or community.
- **Primary footprint** - the sum of direct emissions of greenhouse gases from the burning of fossil fuels for energy consumption and transportation. The emissions you directly release into the atmosphere, such as driving a car or taking a hot shower. .
- **Secondary footprint** - sum of indirect emissions of greenhouse gases during the life cycle of products used by an individual or organization, such as purchasing clothing or food.
- **Carbon offset** - reduction in emissions of carbon dioxide or other greenhouse gases made in order to compensate for emissions made elsewhere. Offsets are measured in tons of carbon dioxide-equivalent.

What is My Ecological Footprint? Activity

- **Carbon credit** - a permit that allows the company that holds it to emit a certain amount of carbon dioxide or other greenhouse gases. One credit permits the emission of a mass equal to one ton of carbon dioxide.

Teacher Preparation

- In preparation for this activity, the teacher should explore different online ecological (carbon) footprint calculators to determine which one(s) will work best with your students. Many online calculators require *Flash Player* which does not work on Chromebooks.

Here are a few examples:

- [The Nature Conservancy](#) This calculator is the most comprehensive. It includes food consumption, transportation choices, and household energy use. It also provides an interface for selecting conservation efforts to reduce emissions and calculates cost savings.
 - [Global Footprint Network](#) This calculator is very extensive, but does require students to enter an email address or log in with Facebook. This includes food consumption, transportation choices, and household energy use. It also will allow students to explore the carbon footprint of schools and businesses. This site also gives many suggestions, including cost savings, for selecting conservation efforts to reduce emissions for households, schools, and businesses.
 - [Environmental Protection Agency \(EPA\)](#) This calculator does not include food consumption but is very detailed about household energy use, transportation choices, and waste. It also provides an interface for selecting conservation efforts to reduce emissions while also calculating cost savings.
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- Trace and cut out a footprint to be placed in a visible area in the classroom (such as on the board) for engagement. Students will also trace and cut out a footprint on Day One. If the length of your class does not allow for this, you can cut them out for each student, give them a photocopied footprint, or omit this step.
 - Assign the student worksheet “Assessing My Ecological Footprint” before beginning this activity. Students will need to acquire specific information on their household size, average cost of energy, and other information most students will not know without asking a parent or guardian.
 - Recommendation - give the assignment a week before you plan to do this activity. It is rather lengthy.
 - Students will fill out the worksheet and do their own personal calculations before working in groups. This worksheet will only be seen by the teacher and the individual student. Teachers, please make this clear to your students to ensure student privacy.
 - Gallery Walk or Graffiti Wall (Engagement Day One). Teacher should write one question on a large sheet of paper or poster board and hang around the room. The number of questions

What is My Ecological Footprint? Activity

depends on the amount of time you have per class or the number of students. Students do not need to go to every question. Use questions such as:

- What does the footprint mean to you?
- How does it relate to climate change?
- What does the words carbon footprint mean to you?
- What does it mean to recycle?
- What are some things you personally do that have a huge affect on the environment?

Materials Required

- Worksheet “Assessing My Ecological Footprint” (per student) - Given to students prior to activity (see note in Teacher Preparation)
- Worksheet “Evaluating My Ecological Footprint” (per student)
- Graphing paper (per student and per group)
- Construction, copy, or butcher paper (per student and per group)
- Computer with Internet and Google Sheets or Excel (per group)
- A traced footprint (engagement)
- Several sheets of paper or poster board for a graffiti/gallery walk posted around the classroom (see “Teacher Preparation” for examples of questions)

Background Information

This lesson will focus on how student choices affect Earth and its resources. They will begin by looking at their personal contribution to greenhouse gases by calculating their household's ecological footprint. Carbon dioxide (CO₂) and methane (CH₄) emissions are what contribute to an ecological (carbon) footprint. Calculating this footprint can take place on many levels - individual, family (household), school, business, city, country, or worldwide.

At the beginning of this lesson, students should be familiar with the following terms to properly calculate their household's ecological footprint (see vocabulary list): primary footprint, secondary footprint, carbon offsets, and carbon credits.

Procedure - Day One

1. Engagement: (Before class, trace and cut out a footprint). Place the footprint in a highly visible spot in the classroom or hold it up to the class. While pointing out (or holding up) the footprint, tell the student to think about the footprint. Give them a minute then let them do a gallery/graffiti walk with the questions you previously hung around the classroom. Let them know at this point there are no right or wrong answers. (See “Teacher Preparation” section for question examples.
2. After giving the students about 15 minutes for the gallery walk, discuss some of the answers written. This would be a good time to review the vocabulary: primary footprint, secondary footprint, carbon offsets, and carbon credits. (10-15 minutes).
3. Demonstrate how to use one of the carbon footprint calculators, walking the class through the process of creating their own carbon footprint. This can be accomplished as a whole

What is My Ecological Footprint? Activity

class using a projector and teacher computer or in small groups as the teacher moves around the room.

4. Using the “Assessing My Ecological Footprint” worksheet students have completed, have students individually calculate their household’s carbon footprint. There are several good online calculators described in the “Teacher Preparation” section. Walk around the room, helping students as necessary.
5. Once they have completed their calculations, have them trace and cut out their footprint from construction or butcher paper. Students should then write their household’s carbon footprint number on the front and their name on the back. These can be posted around the room or on a poster board later, if desired. If time is short, this step can be omitted.

Procedure - Day Two

1. Engagement: Discuss questions from the gallery walk you did not get to on Day One. Review vocabulary for this lesson.
2. Break students into small groups. Students should take their footprint from Day One with them. In the group, students will first compare the similarities and differences among individual footprints. Encourage them to brainstorm the reasons for the differences, especially if there is a large spread in numbers (ie vegetarians will have lower carbon footprints than those who eat beef everyday).
3. Each group will calculate the whole group’s carbon footprint.
4. Each group should create a graph on graphing paper or large piece of paper to display individual footprints versus the group footprint.
5. Working in their groups, students should then brainstorm various ways they can reduce their carbon footprints in realistic ways. This can be written on the back of their graphs. For display purposes, you can have students write this list on a poster board or large sheet of paper.
6. At the end of class, each group should quickly present their group data and some of the ways they discussed for reducing their individual numbers.

Homework (Exit Tickets, etc)

1. Have students generate a graph or chart of individual carbon usage by category (living space, energy, transportation, food, and waste). (This can be an extension activity).
2. Evaluating My Ecological Footprint worksheet (this can also be used as an assessment)

Extensions

1. **Mini-project idea:** Students create a poster displaying realistic ways an individual can reduce their ecological footprint.
2. Calculate the ecological footprint of your class, cafeteria, or whole school.
3. Calculate the ecological footprint of a small business within a mile of your school.
4. Create a tracking system for tracking your personal or your family’s carbon footprint. Track it for the entire school year. Teachers, an end-of-the-year contest will encourage students to reduce their ecological footprint.

What is My Ecological Footprint? Activity

Assessing My Ecological Footprint

Student Worksheet

To ensure student privacy, this worksheet will only be viewed by the individual student and the teacher. It will not be used in a group setting. This worksheet is simply used to gather information that will be needed so student's know what to input into an online footprint calculator.

Living Space

1. How many people live in your home? _____
2. What is your zip code? _____
3. What kind of space do you live in? (check one)

<input type="checkbox"/> Single-family house with running water	<input type="checkbox"/> Apartment building (5-10 apartments)
<input type="checkbox"/> Single-family house without running water	<input type="checkbox"/> Apartment building (more than 10 apartments)
<input type="checkbox"/> Duplex (2-4 units)	<input type="checkbox"/> Luxury condo
	<input type="checkbox"/> Green design residence
4. What is the size of your family's living space? (check one)

<input type="checkbox"/> 550 sq.ft or less	<input type="checkbox"/> 1601-2200 sq.ft.
<input type="checkbox"/> 550-1050 sq.ft.	<input type="checkbox"/> 2201-2700 sq.ft.
<input type="checkbox"/> 1051-1600 sq.ft.	<input type="checkbox"/> 2701 sq.ft. or more
5. Do you have electricity in your home?

<input type="checkbox"/> Yes	<input type="checkbox"/> No
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Energy

6. What is your family household's primary heating source? (check one)

<input type="checkbox"/> Natural gas	<input type="checkbox"/> Wood (ie. fireplace, wood-burning stove)
<input type="checkbox"/> Propane	<input type="checkbox"/> We do not heat our house
<input type="checkbox"/> Heating oil	
<input type="checkbox"/> Electric Heat (ie. central heat/air or baseboard heating)	
7. Does your household purchase green power (ie solar, water, or wind energy)?

<input type="checkbox"/> Yes	<input type="checkbox"/> No
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8. How much electricity does your household use per month
_____ dollars

What is My Ecological Footprint? Activity

_____ kilowatt-hours (use average kilowatt-hours for most accurate estimate)

9. How much heating (fuel) oil does your house use per month?

_____ dollars

_____ gallons

10. How much natural gas does your household use per month?

_____ dollars

_____ therms

_____ thousands of cubic feet (use monthly consumption for most accurate estimate)

11. How much propane does your house use per month?

_____ dollars

_____ gallons

Transportation and Travel

12. How many gasoline-powered vehicles does your household have? _____

13. For each vehicle, fill in the table with the average miles each vehicle is driven per week and average gas mileage.

	Average Miles Driven per Week	Average Gas Mileage
Vehicle 1		
Vehicle 2		
Vehicle 3		
Vehicle 4		
Vehicle 5		
Vehicle 6		

14. How many miles do you or your family travel by bus each week?

1-5 miles

6-25 miles

26-50 miles

51 or more miles

We do not travel by bus

15. How many miles do you or your family travel by train or subway each week? (check one)

1-5 miles

6-25 miles

26-50 miles

51 or more miles

What is My Ecological Footprint? Activity

- We do not travel by bus

16. How often do you or someone in your family carpool? (check one)

- Never Very Often
 Occasionally Almost Always
 Often

17. How many hours do you or your family fly each year? (check one)

- 0-4 hours 26-100 hours
 4-10 hours More than 100 hours
 11-25 hours We never fly

Food Consumption

18. Place an "X" on the table to indicate how often your family eats each of the following foods.

	Never	1x a Month	1-3x a Week	Daily	Every Meal
Beef					
Poultry					
Pork					
Fish & Seafood					
Eggs & Dairy					

19. How much of your diet is based on fresh, unpackaged foods? (check one)

- None Most
 Some All
 Half

Waste and Recycling

20. Besides grocery shopping, how often do you or your family go clothes shopping? (this includes clothing, shoes, and sports/exercise clothing) (check one)

- 1x a month (Only for necessities)
 1-3 times a month (Closets are not quite full)
 1x a week (Love to shop)
 2-3x a week (Have to have all the latest fashions)

What is My Ecological Footprint? Activity

21. How often does your family purchase furniture each year? (check one)

- We redecorate the entire house every year
- Couch, new bedroom set - we update regularly
- A new lamp or small table
- We haven't bought new furniture in years

22. How often does your family purchase appliances? (check one)

- Often to have the newest, most up-to-date model
- Occasionally when the old ones are very outdated
- Infrequently when the old ones are not working well anymore
- Almost never - only when the old appliance are broken and can no longer be fixed

23. How often do you or your family purchase electronics? (check one)

- Often to have the newest, most up-to-date model
- Occasionally when the old ones are very outdated
- Infrequently when the old ones are not working well anymore
- Almost never - only when the old ones are broken and can no longer be fixed

24. How often do you or your family purchase new physical copies of books, magazines, or newspapers? (check one)

- Often (daily newspaper delivery and magazine subscriptions)
- Occasionally (1-2 magazine subscriptions a month)
- Infrequently (only when necessary for school; we borrow or read online usually)
- Never (we borrow or read everything we need online)

25. How much do you and your family recycle? (fill in the table)

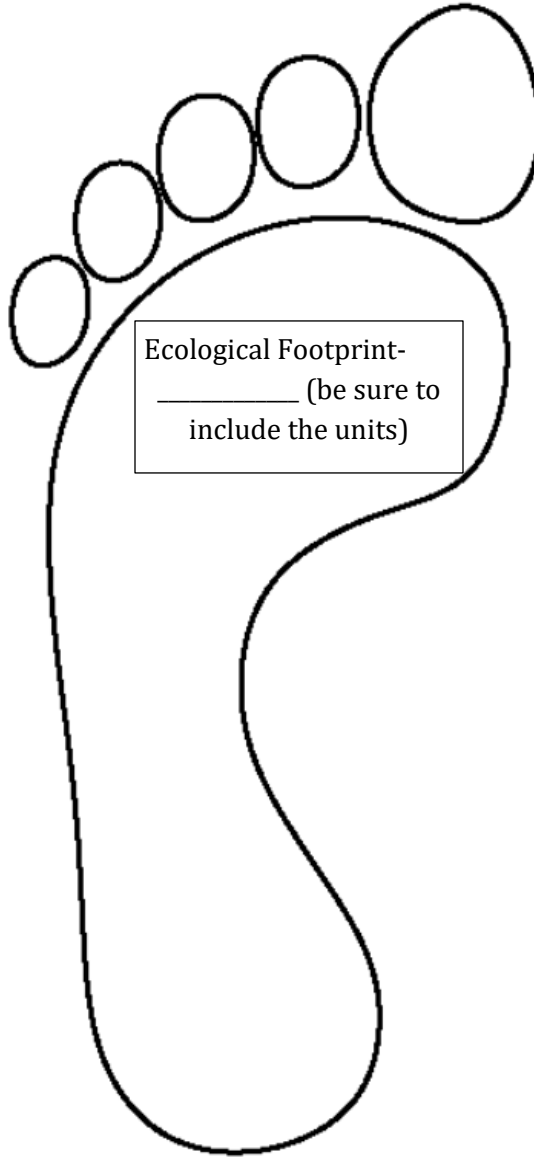
	None	Little	Some	Most of it	All of it
Paper					
Plastic					
Aluminum					
Steel/Tin Cans					
Glass					
Food Waste (Compost)					
Old Electronics					

What is My Ecological Footprint? Activity

Ecological Footprint Calculator Results:

Instructions: After completing your "Assessing My Ecological Footprint Activity", add your ecological footprint that was calculated to the largest part of the foot.

For each toe, list 1 factors that you contributed the most to your footprint from largest contribution (big toe) to smallest (little toe).

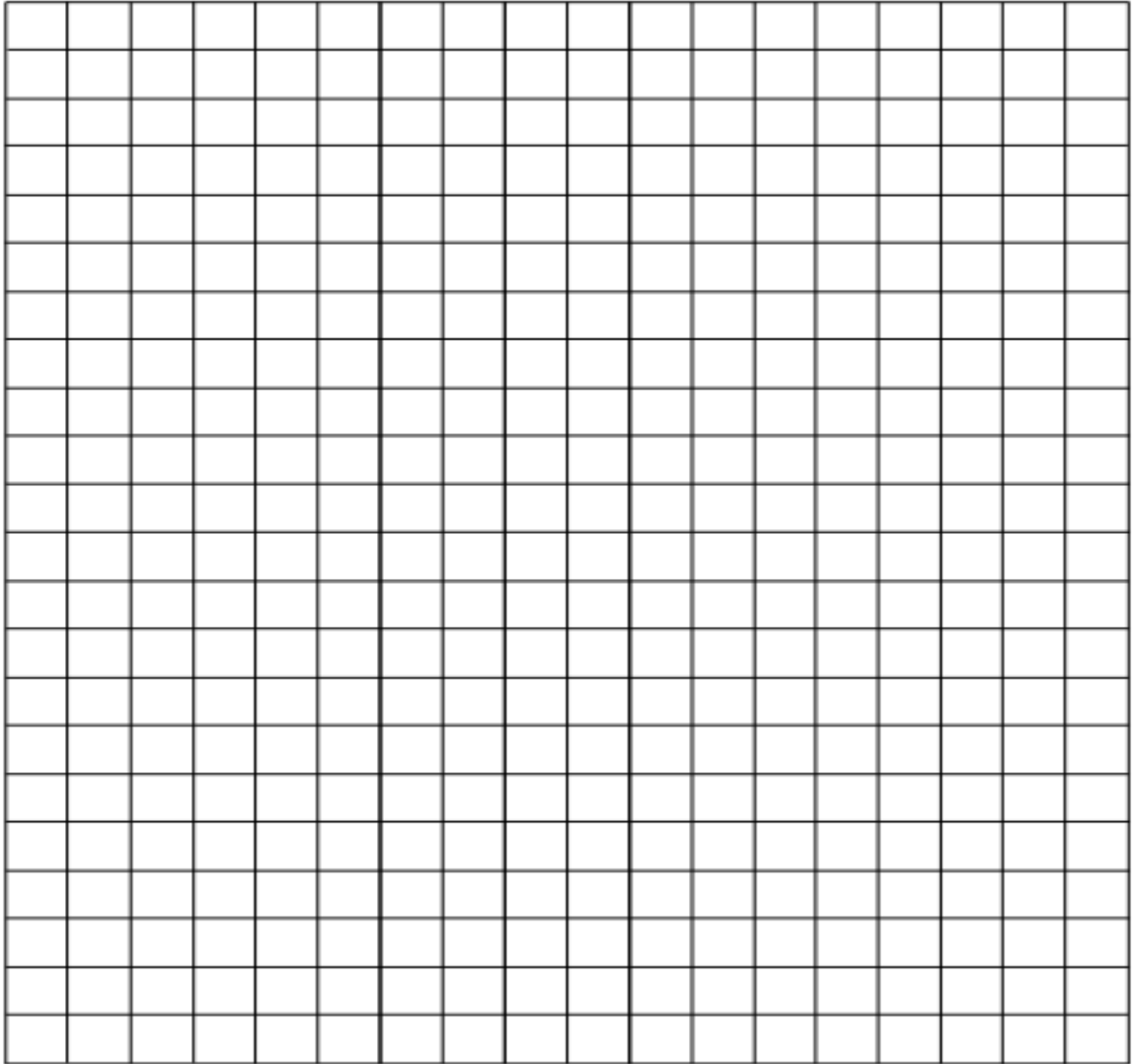


Group Results:

Member	Ecological Footprint

What is My Ecological Footprint? Activity

Bar Graph of Group Results:



What is My Ecological Footprint? Activity

Evaluating My Ecological Footprint Student Worksheet

1. Define the following terms in your own words:
 - a. Carbon footprint

 - b. Carbon offsets

 - c. Carbon credits

2. Give personal examples of the following:
 - a. Primary footprint

 - b. Secondary footprint

3. Using the calculations you did earlier:
 - a. What is your carbon footprint?

 - b. What activity contributes the most of your household's footprint?

4. In your group:

What is My Ecological Footprint? Activity

- a. What is the difference between your personal footprint and the others in your group?
 - b. What is similar?
5. Using group calculations:
 - a. How does the total group's footprint compare to other groups in your class?
 - b. What is similar?
6. List 10 things you and your household can do to reduce your carbon footprint.
7. Think about your school. What do you think is the biggest contributor to its carbon footprint?
8. List 5 things the school can do to reduce its footprint.

**(ANSWER KEY) Evaluating My Ecological Footprint
Student Worksheet**

1. Define the following terms in your own words:
 - a. Carbon footprint - Answer should be in the student's own words: measure of the total amount of carbon dioxide (CO₂) and methane (CH₄) emissions as a result of the activities of a particular individual, organization, or community.
 - b. Carbon offsets - Answer should be in the student's own words: reduction in emissions of carbon dioxide or other greenhouse gases made in order to compensate for emissions made elsewhere. Offsets are measured in tons of carbon dioxide-equivalent.
 - c. Carbon credits - Answer should be in the student's own words: a permit that allows the company that holds it to emit a certain amount of carbon dioxide or other greenhouse gases. One credit permits the emission of a mass equal to one ton of carbon dioxide.
2. Give personal examples of the following:
 - a. Primary footprint - Student answers will vary but could include: driving in a car, heating or cooling a house, cooking on a stove, using a fireplace, the electricity used while watching television. There are many other examples - primary footprint will be anything the student does that personally releases greenhouse gases.
 - b. Secondary footprint - Student answers will vary but could include: buying clothes, eating in a restaurant, throwing away a plastic soda bottle, using plastic bags. There are many other examples - secondary footprint will be anything that releases greenhouse gases indirectly by the student.
3. Using the calculations you did earlier:
 - a. What is your carbon footprint? Answers will vary greatly depending on student lifestyle. A vegetarian or someone who walks to school will have a lower footprint.
 - b. What activity contributes the most of your household's footprint? Answers will vary greatly depending on student lifestyle but could include lots of traveling, eating a lot of meat, overuse of electricity, not recycling.
4. In your group:

What is My Ecological Footprint? Activity

- a. What is the difference between your personal footprint and the others in your group? **Answers will vary.**
 - b. What is similar? **Answers will vary.**
5. Using group calculations:
- a. How does the total group's footprint compare to other groups in your class?
Answers will vary.
 - b. What is similar? **Answers will vary.**
6. List 10 things you and your family can do to reduce your carbon footprint.
Answers will vary but could include activities such as eating less meat, recycling, shopping less often, only buying necessities, using appliances until they can no longer be fixed, walking or bike riding to places more often, hanging laundry outside to dry instead of using a dryer. There are many other examples.
7. Think about your school. What do you think is the biggest contributor to its carbon footprint?
Answers will vary but could include activities such as paper use, indoor lighting, running the buses, air conditioning. There are many other examples.
8. List 5 things the school can do to reduce its footprint.
Answers will vary but could include activities such as using more natural lighting, recycling, offering a vegetarian menu, using reusable dishes and utensils, encouraging students who live close to walk to school. There are many other examples.