How Big is My Ecological Footprint?

Measuring their dependence on nature on a typical day can give students a new understanding of the connection between personal lifestyle choices and the health of the planet

by Tim Turner

Subject areas: mathematics, science, social studies

Key concepts: ecological footprint, lifestyle, sustainability

Skills: lifestyle analysis, critical thinking

Location: indoors

Time: 1 hour

Materials: chart paper, colored markers (blue, green, brown, and black), copy of Personal Eco-Footprint Calculator for each student

Tim Turner

Students calculating their ecological footprints at the Sea to Sky Outdoor School in British Columbia.

Each of us consumes some of the Earth's products and services every day. How much we take depends on the ways in which we satisfy our needs and wants — the many habits that together create our lifestyle. We can ask ourselves these questions to get a better sense of what these habits are: How much water do I use on a typical day? What do I eat and how much do I eat? How much food do I waste? How do I transport myself and how far do I go? How much clothing and footwear do I have and how often do I replace it? What and how much stuff do I buy? How much energy and materials are required to keep me dry and warm/cool? How much garbage do I produce? How much land and energy is used for my recreational activities?

Our answers to these questions reflect the demand that each of us places on nature. In the 1990s, sustainability gurus Mathis Wackernagel and Bill Rees coined the term "ecological footprint" to refer to the load or demand that we place on the Earth's resources. An ecological footprint is a measure of how much of the Earth's biologically productive land and water is needed to produce our food, material goods, and energy, and to absorb our waste.

Having students calculate their ecological footprint gives them a concrete understanding of their own personal impact on the Earth's systems and offers a means of assessing the sustainability of their lifestyles. More than that, engaging students in an ecological footprint analysis elicits curiosity, enthusiasm, and genuine interest in taking action to reduce the demand they place on nature. Students like the fact that the analysis focuses on their own lives, and they understand its clear message: that their choices — and hence they, themselves — can make a difference. Calculating one's ecological footprint reinforces the notion that sustainability is a journey and not a destination and that it is participatory, not a spectator sport. It serves as a simple guide to living, working, and playing in ways that don't cost the Earth.

How much Earth do we have?

Our "living" Earth has a surface area of 51 billion hectares, but less than one quarter of this — under 12 billion hectares — is biologically productive for human use. This is the amount of land available on the planet to

provide all of the food, water, and other materials that we need to support ourselves. To help students visualize this, create a pie graph that shows how the Earth's surface area is divided.

1. Begin by drawing a large circle on chart paper. Explain that the circle represents the surface area of the Earth.
2. Draw lines to divide the pie into land and water: 28 percent of the Earth's surface is land and 72 percent is water.
3. Focusing on the 28 percent of the pie that is land:
   - color about two-thirds of the land area green to represent the 19 percent of Earth's surface that is biologically productive for human use (i.e., land that is fertile enough to support agriculture, forests, or animal life).
   - color the other third of the land area brown to represent the 9 percent of Earth's surface that is marginally productive or unproductive for human use (e.g., land that is paved, covered by ice, lacks water, or has unsuitable soil conditions).
4. Explain that processes such as desertification, soil erosion, and urbanization are constantly reducing the amount of biologically productive land on Earth. To show this, draw small brown tentacles reaching from the border of the brown segment into the green segment.
5. Now, focusing on the water realm:
   - color about one-twentieth of the water section blue to show that 4 percent of the Earth's surface is lakes and oceans that are biologically productive for human use (i.e., yield more than 95 percent of the global fish catch).
   - color the remaining section black to show that 68 percent of the Earth's surface is ocean that is marginally productive or unproductive for human use (i.e, yields only about 5 percent of the global fish catch).
6. Draw black "tentacles" from the unproductive-water segment to the productive-water segment to represent processes that contribute to loss of fertility in lakes and oceans. These include the destruction of coral reefs, oil spills, overfishing (of both marine and lake species), and shoreline development.
7. This leaves a pie chart featuring four segments of varying sizes — an excellent picture of our "living" planet. Label the sections, noting the percentage of the Earth's surface that each represents and listing the forces represented by the "tentacles."

Wrap-up: Remind students that only the green and blue sections — about 23 percent of the Earth's surface — are biologically productive. This small percentage of land and water is all we have to produce all of our food, materials, and energy, and to absorb our waste. These precious slices of the Earth's surface are also needed by the other 10 million or more species with whom we share the planet.

Three Facts and One Inescapable Conclusion!

Fact #1: Of the 51 billion hectares of the Earth's surface, only 12 billion hectares are biologically productive and therefore capable of providing resources and treating waste. That's 10 billion hectares of land and 2 billion hectares of water.

Fact #2: The human population is 6.3 billion and climbing. Of the biologically productive land and water that is available, our average Earth share is 1.9 hectares per person (not including the needs of all other life forms). As our population grows, we must either reduce our average Earth share or find more Earths to inhabit.

Fact #3: The amount of biologically productive land on Earth is in decline owing to urbanization, overgrazing by livestock, deforestation, toxic contamination, poor agricultural practices, desertification, and global climate change.

Inescapable conclusion: Less is more: we all need to shrink our ecological footprint.

Calculating a footprint

Have students complete the Personal Eco-Footprint Calculator to estimate how much of the Earth's biologically productive land and water is needed to support their own lifestyles. The calculator is divided into eight categories that represent the many ways that we "consume" nature each day. Explain to students that it is not a scientific survey, but it does give a good approximation of the impact of one's lifestyle on a typical day. More detailed lifestyle analyses include other considerations that usually increase the size of one's ecological footprint. Therefore, the calculation derived from this calculator should be seen as a simplification and an underestimate of reality.

Students may point out that some lifestyle choices, such as the size of their house or the number of family cars, are not under their direct control. Explain that the calculator is meant to provide a snapshot of their lives at present, and that the baseline information they gather will help them to monitor the impact of changes they make in their lifestyles. They may, for example, make different choices if they purchase their own house or car in the future. The connection between these lifestyle considerations and their future ecological footprints is an important learning outcome of using the Footprint Calculator.

Personal Eco-Footprint Calculator

Procedure: Complete each of the charts for a typical day in your home community. Add the points on each chart to obtain a subtotal for that category, and transfer it to the summary chart. Use the grand total to calculate your ecological footprint.

Water Use **My Score**

1. My shower (or bath) on a typical day is: _____
   - No shower / no bath (0)
   - 1–2 minutes long / one-fourth full tub (50)
   - 3–6 minutes long / half full tub (70)
   - 10 or more minutes long / full tub (90)
2. I flush the toilet: _____
   - Every time I use it (40)
   - Sometimes (20)
3. When I brush my teeth, I let the water run. (40) _____
4. I washed the car or watered the lawn today. (80) _____
5. We use water-saving toilets (6-9 liters/flush). (-20) _____
6. We use low-flow showerheads (-20) _____
7. I use a dishwasher on a typical day. (50) _____

Subtotal: _____

Food **My Score**

1. On a typical day, I eat:
   - Beef (150/portion) _____
   - Chicken (100/portion) _____
   - Farmed fish (80/portion) _____
   - Wild fish (40/portion) _____
   - Eggs (40/portion) _____
   - Milk/dairy (40/portion) _____
   - Fruit (20/portion) _____
   - Vegetables (20/portion) _____
   - Grains: bread, cereal, rice (20/portion) _____
2. ____ of my food is grown locally. _____
   - All (0)
   - Some (30)
   - None (60)
3. ____ of my food is organic. _____
   - All (0)
   - Some (30)
   - None (60)
4. I compost my fruit/vegetable scraps and peels. _____
   - Yes (-20)
   - No (60)
5. ____ of my food is processed. _____
   - All (100)
   - Some (30)
   - None (0)
6. ____ of my food has packaging. _____
   - All (100)
   - Some (30)
   - None (0)
7. On a typical day, I waste: _____
   - None of my food (0)
   - One-fourth of my food (100)
   - One-third of my food (150)
   - Half of my food (200)

Subtotal: _____

Transportation **My Score**

1. On a typical day, I travel by: _____
   - Foot (0)
   - Bike (5 per use)
   - Public transit (30 per use)
   - Private vehicle (200 per use)
2. Our vehicle's fuel efficiency is ____ liters/100 kilometers (gallons/60 miles). _____
   - less than 6 liters / 2 gallons (-50)
   - 6–9 liters / 2–2½ gallons (50)
   - 10–13 liters / 3–3½ gallons (100)
   - More than 13 liters / 3½ gallons (200)
3. The time I spend in vehicles on a typical day is: _____
   - No time (0)
   - Less than half an hour (40)
   - Half an hour to 1 hour (60)
   - More than 1 hour (100)
4. How big is the car in which I travel on a typical day? _____
   - No car (-20)
   - Small (50)
   - Medium (100)
   - Large (SUV) (200)
5. Number of cars in our driveway? _____
   - No car (-20)
   - 1 car (50)
   - 2 cars (100)
   - More than 2 cars (200)
6. On a typical day, I walk/run for: _____
   - 5 hours or more (-75)
   - 3 to 5 hours (-25)
   - 1 to 3 hours (0)
   - Half an hour to 1 hour (10)
   - Less than 10 minutes (100)

Subtotal: _____

Shelter **My Score**

1. Number of rooms per person (divide number of rooms by number of people living at home) _____
   - Fewer than 2 rooms per person (10)
   - 2 to 3 rooms per person (80)
   - 4 to 6 rooms per person (140)
   - 7 or more rooms per person (200)
2. We share our home with nonfamily members. (-50) _____
3. We own a second, or vacation home that is often empty. _____
   - No (0)
   - We own/use it with others. (200)
   - Yes (400)

Subtotal: _____

Personal Eco-Footprint Calculator

Energy Use **My Score**

1. In cold months, our house temperature is: _____
   Under 15ºC (59ºF) (-20)
   15 to 18ºC (59 to 64ºF) (50)
   19 to 22ºC (66 to 71ºF) (100)
   22ºC (71ºF) or more (150)
2. We dry clothes outdoors or on an indoor rack. _____
   Always (-50)
   Sometimes (20)
   Never (60)
3. We use an energy-efficient refrigerator. _____
   Yes (-50)
   No (50)
4. We use compact fluorescent light bulbs. _____
   Yes (-50)
   No (50)
5. I turn off lights, computer, and television when they're not in use. _____
   Yes (0)
   No (50)
6. To cool off, I use: _____
   Air conditioning: car / home (30 for each)
   Electric fan (-10)
   Nothing (-50)
7. Outdoors today, I spent: _____
   7 hours (0)
   4 to 6 hours (10)
   2 to 3 hours (20)
   2 hours or less (100)

Subtotal: _____

Clothing **My Score**

1. I change my outfit every day and put it in the laundry. (80) _____
2. I am wearing clothes that have been mended or fixed. (-20) _____
3. One-fourth of my clothes are handmade or secondhand. (-20) _____
4. Most of my clothes are purchased new each year. (120) _____
5. I give the local thrift store clothes that I no longer wear. _____
   Yes (0)
   No (100)
6. I buy hemp instead of cotton shirts when I can. (-10) _____
7. I never wear ___ % of the clothes in my cupboard. _____
   Less than 25% (25)
   50% (50)
   75% (75)
   More than 75% (100)
8. I have ____ pairs of shoes. _____
   2 to 3 (20)
   4 to 6 (60)
   7 or more (90)

Subtotal: _____

Stuff **My Score**

1. All my garbage from today could fit into a: _____
   Shoebox (20)
   Large pail (60)
   Garbage can (200)
   No garbage created today! (-50)
2. I reuse items rather than throw them out. (-20) _____
3. I repair items rather than throw them out(-20) _____
4. I recycle all my paper, cans, glass, and plastic.(-20) _____
5. I avoid disposable items as often as possible. _____
   Yes (-10)
   No (60)
6. I use rechargeable batteries whenever I can. (-30) _____
7. Add one point for each dollar you spend in a typical day. _____
   Today was a Buy Nothing Day (0) _____

Subtotal: _____

Fun **My Score**

1. For typical play, the land converted into fields, rinks, pools, gyms, ski slopes, parking lots, etc., added together occupy: _____
   Nothing (0)
   Less than 1 hectare / 2½ acres (20)
   1 to 2 hectares / 2½ to 5 acres (60)
   2 or more hectares / 5 or more acres (100)
2. On a typical day, I use the TV or computer _____
   Not at all (0)
   Less than 1 hour (50)
   More than 1 hour (80)
3. How much equipment is needed for typical activities? _____
   None (0)
   Very little (20)
   Some (60)
   A lot (80)

Subtotal: _____

Summary

Transfer your subtotals from each section and add them together to obtain the grand total.

Water use _____
Food _____
Transportation _____
Shelter _____
Energy Use _____
Clothing _____
Stuff _____
Fun _____

Grand Total: _____

My ecological footprint is:
Grand Total divided by 100 = _____ hectares
(To convert to acres, multiply hectares by 2.47)

Sharing Earth fairly

Once students have calculated their ecological footprints, they can compare their results with others and determine whether the Earth could sustain the human population if everyone lived as they do.

1. Have students consider how their results compare with the following average ecological footprints:
   United States: 10 hectares (24 acres) per person
   Canada: 9 hectares (22 acres) per person
   Italy: 4 hectares (9 acres) per person
   Pakistan: less than 1 hectare (2 acres) per person
2. Have students calculate how much of Earth's biologically productive land is available to each person on the planet. To do this, they divide the total area of biologically productive land (12 billion hectares) by the number of people on the planet (about 6.3 billion). This amount (1.9 hectares / 4.7 acres per person) is known as the Average Earth Share.
3. Have students calculate how many Earths would be needed if every human had an ecological footprint the size of theirs. To do this, they divide their ecological footprint by the Average Earth Share. (If the ecological footprint is in acres, divide by 4.7; if it is in hectares, divide by 1.9.) Discuss: How many additional Earths would be needed to meet human demands if everyone lived as we do? What insights come from this knowledge?

Wrap-up: To follow up, remind students that the limited amount of biologically productive land that supports us also needs to provide food, water, and shelter for more than 10 million other species. These needs were not factored into the Average Earth Share, which represents the needs of humanity only. Consider, too, the implications of living in a world where 80 percent of the human family use 20 percent of available resources, while 20 percent (i.e., those of us in wealthier countries) use 80 percent of available resources.

Extensions:

- An ecological footprint calculation provides a baseline from which to measure progress toward a smaller footprint and a more sustainable lifestyle. Challenge students to set goals for themselves in each lifestyle category (i.e., to eat less meat or to spend more time outdoors) and have them calculate their footprints again after an agreed-upon interval of time.
- The Personal Eco-Footprint Calculator assumes that the habits identified reflect how one always lives; however, we know that lifestyle is influenced by factors such as a person's age or time of year, and an ecological footprint will expand or shrink accordingly. Many residential outdoor and environmental education centers ask visiting students to calculate their ecological footprint twice: the first calculation is based on their activities on a typical day at the center, while the second is based on their daily routines and habits at home. Students often find that their ecological footprint is as much as 400 percent larger at home, yet most agree that the simplified living in the outdoor center ranks high on their quality-of-life index. This exercise provides a helpful comparison that debunks the myth that a person's quality of life is directly proportional to consumption.

Tim Turner is a sustainability educator with the Sea to Sky Outdoor School located on Keats and Gambier islands in Howe Sound, northwest of Vancouver, British Columbia.

RESOURCES

Wackernagel, Mathis, and William Rees. *Our Ecological Footprint: Reducing Human Impact on the Earth.* New Society Publishers, 1995.

<www.ecofoot.net> The most extensive site for educators interested in using the ecological footprint tool with their students.

<www.panda.org/news_facts/publications/general/livingplanet> WWF's Living Planet Report lists the ecological footprints of 150 countries.

<www.davidsuzuki.org> David Suzuki's Nature Challenge identifies the ten best things one can do to protect nature. This is an excellent follow-up project to helps students in their ongoing efforts to shrink their ecological footprint.

<www.seatosky.bc.ca> The Sea to Sky Outdoor School website provides access to such teaching resources as the Ecospherotron, Lifesavers, and Earth 100, which complement the ecological footprint.

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