

Backyard STEM for Tennessee 4-H

Carbon Footprints: How big is your shoe?



Learning Objectives

Students will be able to:

1. Draw a connection between modes of transportation and carbon emissions.
2. Use a digital mapping application to measure distance.
3. Calculate their carbon footprint.
4. Evaluate information in order to make an informed decision.

Setting the Stage

How many miles do you travel to get to school each day? What type of transportation do you use to get to school, a vehicle, the bus, a bike? These two answers are all that are needed to in this activity, where we will calculate the amount of carbon emitted into the atmosphere, or the “carbon footprint,” of traveling to and from school.

The leading cause of greenhouse gas emissions in the United States is transportation. The national average time to commute to work is 26 minutes by personal vehicle. Over 76% of adults drive alone in a personal vehicle to get to work each day. For each mile traveled by a person alone in a vehicle, about 0.89 lbs of carbon are emitted into the atmosphere. Compare this to the 0.02 lbs emitted each mile during biking or 0.11 emitted while busing, and it is easy to see that the biggest carbon “shoe” is the personal vehicle.

Materials:

- Worksheets
- Pen/pencil
- Ruler
- Calculator
- Internet accessible device (optional)
- Sand, scoop, plastic bags with ties, kitchen scale 0-10 lbs (optional)

Total U.S. Greenhouse Gas Emissions by Economic Sector in 2016

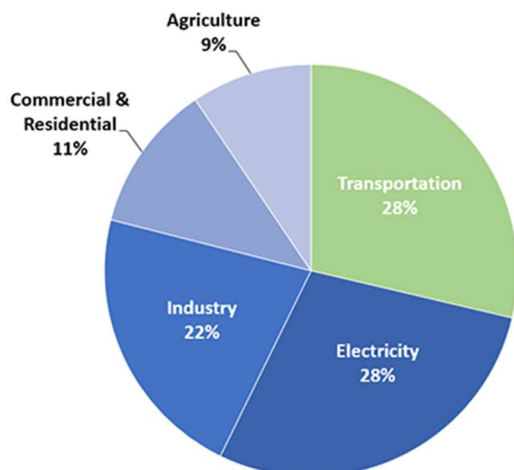


Figure 1. United States Environmental Protection Agency:
<https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions>

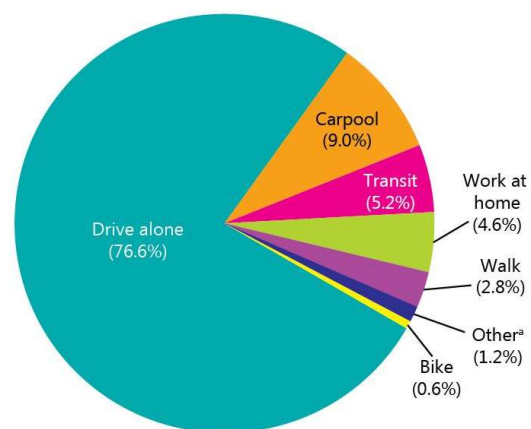


Figure 2. <https://www.bts.dot.gov/content/commute-mode-share-2015>

Activity

The carbon footprint activity is intended to be used in scenarios of students' school commute (e.g. the typical daily transportation from their home to school). In order to find the commute distance, student need to know their home addresses and the address of the school. Either ask them to bring this information to the session or have this available for them. Alternatively, this activity can be used to calculate the carbon footprint of going from school to the grocery store each week, or the public library, or some other community center. This would alleviate any need to work with students' personal home addresses.

To execute the activity, use the worksheet and following the following steps:

1. Display the two pie charts and bar graph and discuss the effects of transportation on carbon emissions. Option: Use sand or marbles to weight out the equivalent weight of carbon emission per mile of transportation modes (ie. 0.02 lbs for biking/walking, 0.11 for busing, and 0.89 for personal vehicle). Put these in plastic bags and label with transportation mode. Pass around the classroom to allow students to physically feel the difference in weight.
2. Ask students to use either Arcgis.com or google maps to find the distance of their school commute. A step-by-step instruction guide is provided here these technologies. Alternatively, you may give the students a distance to use in a scenario of school to grocery store, library, etc.
3. Ask students to complete the worksheet. Discuss as needed.
4. As students determine their daily or weekly footprint weights, ask them to weight out their carbon emissions total in sand using the kitchen scale. If their emission is more than the capacity of the scale, they can make multiple measurements and add it together in the same bag. Label the bags with masking tape and sharpie with the weight. Students can compare and contrast their weights.

Go Further

One option is to tie in old technology with the new. Bring to class a printed city or county map. Discuss with students the use of the scale and a ruler or push pins and a string to manually measure distance. Compare this to the use of digital mapping applications.

Arcgis.com can also be used to create "Drive time Areas" that outlines an area of land that is reachable given a certain drive time. Use the "Drive time Areas" analysis tool with entered drive times of 5 minutes, 10 minutes, and 15 minutes (or longer for more rural areas). Ask students to investigate drive time areas. Students may use the measure function to measure the linear length and width of their drive time areas to compare between them or between each other.

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Step-by-Step Instructions for ArcGIS.com

1. Go to www.arcgis.com in a browser.
2. Click "Sign in"
3. Select "Enterprise login" towards the bottom.
4. Enter the network "myutk" in the box.
5. Sign on with NetID and password.
6. Click "Map" in the upper left.
7. Type in the school address in the search bar.
8. Click the location indicator and select "Add to Map Notes."
9. Click "..." under new Map Notes layer and select "Rename" option.
10. Name the map notes as "School."
11. From "Add" dropdown menu, select "Add Map Notes."
12. Type in Name as "Home" and click create.
13. Type in your home address in the search bar.
14. Click the down arrow on the "Add to Map Notes" button and select "Home."
15. Click the "Analysis" icon in the upper left of the menu bar.
16. Select the "Use Proximity" dropdown.
17. Select "Connect Origins to Destinations" option.
18. In the first field (origin location), select "Home (Points)"
19. In the second field (destination), select "School (Points)."
20. In the third field, select "Driving Distance" from the dropdown.
21. Leave the remainder of the fields in default.
22. Unclick the "Use current map extent" option in the very bottom.
23. Click "Run Analysis."
24. Observe the driving path from Home to School.
25. Click on the route to see the distance reported in the pop up window.
26. Use this distance in the activity.

Driving Distance from Home to School: _____ miles.

Step-by-Step Instructions for Google Maps.

1. Go to www.maps.google.com
2. In the search bar, type in your home address and press Enter. Verify the red flag looks correct on the map.
3. Select the blue directional arrow on the left of the screen labeled "Directions."
4. In the new box that appeared labeled "Your Location," type the school address and press enter.
5. A list of alternative routes will appear listed in the box on the left as well as highlighted on the screen. Select the distance associated with your most commonly used route, or for those who don't know, just use the top option. The distance is presented in miles under the time.

Driving Distance from Home to School: _____ miles.