Lesson Title:	Carbon Footprint Calculator
Grade Level:	High School
Subject:	Chemistry
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Engagement:

- Prior to the lesson, the students will know how to do basic conversions such as watts to kilowatts. Students will understand the carbon cycle and its effects as a greenhouse gas on the environment. Student will know what energy is, how we use it in our everyday lives, and how energy is transferred to homes, schools, etc.

- This lesson uses pounds per year as the final conversion so that students can better understand the vast amount of carbon dioxide that is released. However, this lesson can be easily modified to use kilograms, metric tons, etc.

- To begin, students will watch a video about carbon footprints: https://www.youtube.com/ watch?v=8q7_aV8eLUE. After the video, students will be asked to individually calculate their carbon footprint using an online calculator: https://www3.epa.gov/carbon-footprint-calculator/. Students should be asked to think about the amount of electricity they use as they complete their footprint. How often do we charge our phones? Leave the TV plugged in? During this time, the instructor can introduce the Kill A Watt Electricity Usage Monitor to the class and allow students to test their phones or electronic devices on the meter.

Source: https://worldculturenetwork.com/how-to-reduce-the-carbon-footprint/
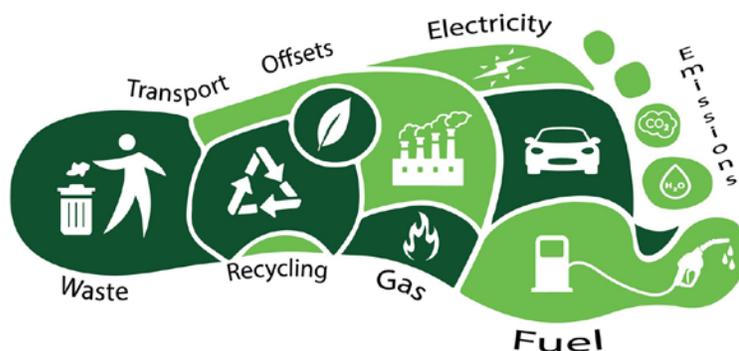
Exploration:

- To begin, the instructor should ask students how they were able to calculate their footprint. The instructor can then introduce the activity which will be students dissecting calculator code in python. Students will work in pairs with a paper copy of code and write what each line of code is doing. Students will be encouraged to use online resources to aid in the deciphering.

Explanation:

- The python code will be projected and student pairs or individuals may explain a section of the code to the class. Students will have the opportunity to agree, disagree, or ask questions that the presenting pair/individual will need to respond to. Once students have explained the code as much as they can, the teacher will explain anything missed and answer further questions.

Elaboration:

- Students will work in the same pairs to write code for their own carbon footprint program. It will be separated into three parts. For the first part, students will use the kWH value found on a PECO or energy bill to calculate the average annual amount of carbon dioxide released. The code should have the user input this kWh value and output the converted amount in pounds per year. For the second part, students will use the average monthly natural gas value (ccf value) found within the PECO or energy bill and output the annual amount of carbon dioxide released in pounds per year. The third part of the program will require students to plug a phone or electronic device into a Kill A Watt Electricity Usage Monitor and obtain the kWh that the device uses. The code should have the user input the kWh, but also have the user input the average daily hours spent charging that device. From there, the code should turn this daily value into an average yearly value, which can then be converted to the amount of carbon dioxide released in pounds per year. An annual combined amount should be displayed at the end. An example of this code is found here: https://repl.it/@EricaWalk/Carbon-Footprint-Calculator

Evaluation:

- The teacher will give students an exit ticket to answer questions individually on what they learned throughout the lesson. The students will be asked, "What does the function, input, mean?", "What is the command for defining a variable with a fractional value?", and "What is a carbon footprint?". The teacher can review the students' answers and discuss them with students the next day.

Code:

print("The purpose of this program is to calculate your average annual carbon footprint.\nWhen prompted, enter the values found on your electric bill or on the meter.")

#Because we are finding an annual value, the kwh value is multiplied by 12 for the months in a year. The value 1.22 is then multiplied for the conversion of kwh to lbs.

x = float(input("Enter the average monthly kilowatts per hour from your electric bill. "))*12*1.22

if x < 0:

  print("Please enter a positive number. ")

elif x==0:

  print("Are you sure you didn't use any electricity at all? Please enter a non-zero number. ")

else:

  print("For electricity, the amount of carbon dioxide released is: ", x, "lbs/yr")

#Because we are finding an annual value, the kwh value is multiplied by 12 for the months in a year. The value 29 is then multiplied for the conversion of ccf to kwh. To convert this kwh value to lbs, multiply 1.22.

y = float(input("Enter the average monthly ccf value found on your electricity bill. "))*12*29*1.22

if x < 0:

  print("Please enter a positive number. ")

elif x==0:

  print("Are you sure you didn't use any gas at all? Please enter a non-zero number. ")

```
else:

  print("For gas, the amount of carbon dioxide released is: ", y, "lbs/yr")
```

#The value for the device is different that the other parts. For this, the user must input the value from the meter which is in kwh. However, phones shouldn't charge all day long for the entire year, therefore we must ask the user how many hours on average a day do they charge their phone. From there, we can then give an average annual value by: average hour a day * 7 days per week * 52 weeks in a year.

```
z = float(input("Now, please plug your cell phone into a Kill a Watt Meter. Enter the value for the kWH. "))

if x < 0:

  print("Please enter a positive number. ")

elif x==0:

  print("Please enter a non-zero number. ")

hours = int(input("Enter the number of hours per day you charge your phone for. "))*7*52

if x < 0:

  print("Please enter a positive number. ")

elif x==0:

  print("Please enter a non-zero number. ")
```

#The value 1.22 is multiplied to the prodcut of the kwh input value and the number of hours charged in one year to give the carbon dioxide released in one year.

```
z_total = z*hours*1.22

total = x+y+z_total

print("The average annual amount of carbon dioxide released is: ", total, "lbs/yr")
```