Teacher's Guide: Greenhouse Gases Around the World (with Answers)

(You can find the student version right after this teacher's guide)

1. Glossary - 5 min

Greenhouse gas – A gas that traps heat in the air and makes the Earth warmer. (Example: Carbon dioxide from cars and factories.)

Greenhouse gas emissions – The total amount of pollution a country releases into the air.

Greenhouse gas emissions per person – The amount of pollution divided by all the people in a country.

2. Mean, Median, and Range - 15 min

Below is a list of 10 countries with their respective total emissions of greenhouse gases and their emissions of greenhouse gases per person.

Country	Total emissions (million tons)	Emissions per person (tons)
Australia	581	22
Switzerland	40	4.5
United States	5,890	17.2
Saudi Arabia	879	24.6
El Salvador	11	1.7
China	13,970	9.8
Algeria	283	6.1
Uganda	65	1.3
Germany	671	7.9
India	4,200	2.9

Your students need to calculate the mean, median, and range for both total emissions and emissions per capita. Before you start, ask them which formulas they have to use and ask them to write it down on their worksheet.

Calculate the Mean (Average)

Formula: Mean = (Sum of all values) ÷ (Number of values)

Sum of all values = 581 + 40 + 5,890 + 879 + 11 + 13,970 + 283 + 65 + 671 + 4,200 = 26,590

Number of values = 10

Total Emissions Mean = 26,590 / 10 = 2,659 million tons

Sum of all values = 22 + 4.5 + 17.2 + 24.6 + 1.7 + 9.8 + 6.1 + 1.3 + 7.9 + 2.9 = 98

Number of values = 10

Per Person Emissions Mean: 98 / 10 = 9.8 tons

Find the Median

Formula: Step 1: List the numbers in order. Step 2: Find the middle value (if there are two, find their average).

11 < 40 < 65 < 283 < **581 < 671** < 879 < 4,200 < 5,890 < 13,970

Total Emissions Median = (581 + 671) / 2 = 1,252 / 2 = 626 million tons

1.3 < 1.7 < 2.9 < 4.5 < **6.1 < 7.9** < 9.8 < 17.2 < 22 < 24.6

Per Person Emissions Median = (6.1 + 7.9) / 2 = 14 / 2 = 7 tons

Find the Range

Formula: Range = Largest value – Smallest value

Largest value = 13, 970 (China)

Smallest value = 11 (El Salvador)

Total Emissions Range = 13,970 - 11 = 13,959 million tons

Largest value = 24.6 (Saudi Arabia)

Smallest value = 1.3 (Uganda)

Per Person Emissions Range = 24.6 - 1.3 = 23.3 tons

3. Comparison to US per person emissions - 15 min

Now, for each country, ask your students to calculate how many people from that country would emit the same amount as one person in the US. The US emissions per person = 17.2 tons.

Again, ask them which formula they need to use and have them write it down on their worksheet.

Formula: Number of People from Country X = US emissions per person / Country X's emissions per person

You can do the example of Switzerland with them:

Number of people from Switzerland = 17.2 / 4.5 = 3.8

So, 3.8 citizens from Switzerland emit as much as 1 person in the U.S.

Country	Emissions per person (tons)	US equivalent
Australia	22	0.78
Switzerland	4.5	3.8
Saudi Arabia	24.6	0.7
El Salvador	1.7	10.1
China	9.8	1.8
Algeria	6.1	2.8
Uganda	1.3	13.2
Germany	7.9	2.2
India	2.9	5.9

4. Difference between total and per person emissions - 15 min

Now, ask your students to write down the list of countries from the one that pollutes the least to the one that pollutes the most, both for total emissions and per person emissions.

Make sure they have the correct orders.

Now, ask them to think about how each country's rank has evolved from the total emissions order to the per person emissions order. They need to complete the table.

Example:

Australia is ranked 6th for global emissions and 2nd for per person emissions.

Difference = 6 - 2 = 4

Country	Rank for total emissions	Rank for per capita emissions	Differences in rank (per person - total)
Australia	6	2	4
Switzerland	9	7	2
United States	2	3	-1
Saudi Arabia	4	1	3
El Salvador	10	9	1
China	1	4	-3
Algeria	7	6	1
Uganda	8	10	-2
Germany	5	5	0
India	3	8	-5

5. Why Do Some Countries Pollute More Per Person? - 10 min

Ask your students the following questions: Did the order change between total and per person emissions? What countries have been the most affected? Why do you think this happened?

Observations: Countries like China and India rank high in total emissions but low in per person emissions because of their large populations. Countries like Saudi Arabia, Australia, and the U.S. have much higher per person emissions, meaning individuals use more energy/resources.

Key Explanation: Some countries have a lot of people, so even if they pollute a lot in total, each person's share is smaller. Other countries have fewer people, but each person uses more energy, so their pollution per person is bigger.

Pizza Example for Students: Imagine you and your friend both get a pizza. If your friend has 4 people to share with, each person gets a smaller piece. If you eat alone, you get the whole pizza! Pollution works the same way—countries with more people spread their pollution out, so each person's amount is smaller.

Real-World Examples: China and India have a lot of pollution, but they also have billions of people. That means the pollution is spread out, so each person's share is smaller. The United States has fewer people, but each person uses more energy (cars, electricity, factories), so their pollution per person is higher.

Extra Tip: You could also encourage students to think about what changes could be made to reduce per capita emissions, especially in countries where people pollute more individually. This would promote critical thinking around possible solutions.

6. Wrap-up - 5 min

It may be helpful to add a short wrap-up or reflection at the end of the lesson. For example, ask students to share one thing they learned or how they would talk to others about pollution and climate change after this lesson.

Student's Worksheet: Greenhouse Gases Around the World

Name: _____

Date: _____

1. Glossary - 5 min

Greenhouse gas – A gas that traps heat in the air and makes the Earth warmer. (Example: Carbon dioxide from cars and factories.)

Greenhouse gas emissions – The total amount of pollution a country releases into the air.

Greenhouse gas emissions per person – The amount of pollution divided by all the people in a country.

2. Mean, Median, and Range - 15 min

Below is a list of 10 countries with their respective total emissions of greenhouse gases and their emissions of greenhouse gases per person.

Country	Total emissions (million tons)	Emissions per person (tons)
Australia	581	22
Switzerland	40	4.5
United States	5,890	17.2
Saudi Arabia	879	24.6
El Salvador	11	1.7
China	13,970	9.8
Algeria	283	6.1
Uganda	65	1.3
Germany	671	7.9

India	4,200	2.9

You have space below each number to do your calculations.

Calculate the Mean (Average)

Formula:

Total Emissions Mean: _____

Per Person Emissions Mean: _____

Find the Median

Formula:

Total Emissions Median: _____

Per Person Emissions Median: _____

Find the Range

Formula:

Total Emissions Range: _____

Per Person Emissions Range: _____

3. Comparison to US per person emissions - 15 min

For each country, calculate how many people it would take to emit the same amount as one person in the US. The US emissions per person = 17.2 tons.

Formula:

Example:

Number of people from Switzerland = 17.2 / 4.5 = 3.8

So, 3.8 citizens from Switzerland emit as much as 1 person in the U.S.

Now, complete the table, you can use the space below to do your calculations.

Country	Emissions per person (tons)	US equivalent
Australia	22	
Switzerland	4.5	3.8
Saudi Arabia	24.6	
El Salvador	1.7	
China	9.8	
Algeria	6.1	
Uganda	1.3	
Germany	7.9	
India	2.9	

4. Difference between total and per person emissions - 15 min

Write down the list of countries from the one that pollutes the least to the one that pollutes the most, both for total emissions and per person emissions. Think about how each country's rank has evolved from the total emissions order to the per person emissions order.

Formula:

Example:

Australia is ranked 6th for global emissions and 2nd for per person emissions.

Difference = 6 - 2 = 4

Now, complete the table, you can use the space below to do your calculations.

Country	Rank for total emissions	Rank for per capita emissions	Differences in rank
Australia	6	2	4
Switzerland			
United States			
Saudi Arabia			
El Salvador			
China			
Algeria			
Uganda			
Germany			
India			

5. Why Do Some Countries Pollute More Per Person? - 10 min

Did the order change between total and per person emissions? What countries have been the most affected? Why do you think this happened?

Key Explanation: Some countries have a lot of people, so even if they pollute a lot in total, each person's share is smaller. Other countries have fewer people, but each person uses more energy, so their pollution per person is bigger.

6. Wrap-up - 5 min

Write 2-3 sentences about what you learned today. How will this information change the way you think about pollution and climate change?