Student Activity Sheet: Creating a Greenhouse Gas Index, 1991

Introduction: The impact of human activities on the Earth's climate is under intense scientific study. Human activity is increasing the concentrations of greenhouse gases (carbon dioxide, methane, CFCs, and nitrous oxide) and the trend, if continued, is expected by atmospheric scientists to lead to global climate change with uncertain, but potentially grave long-term effects.

Despite temporary declines in greenhouse gas emissions in 1991 as a result of changes in the growth of the industrial world's energy consumption and the lower estimates of tropical deforestation, the concentrations of greenhouse gases continue to rise. The ***Intergovernmental Panel on Climate Change (IPCC)*** has estimated that an immediate 60 percent reduction in emissions of long-lived gases would be required to stabilize the atmospheric concentrations. As long as concentrations continue rise, so does the warming potential of the atmosphere and hence the risk of global climate change.

Rank	Country	Percent	Rank	Country	Percent
1.	United States	19.14	26.	Czechoslovakia	0.70
2.	Former Soviet Union	13.63	27.	Malaysia	0.61
3.	China	9.92	28.	Colombia	0.61
4.	Japan	5.05	29.	Netherlands	0.59
5.	Brazil	4.33	30.	Philippines	0.59
6.	Germany[a]	3.75	31.	Myanmar	0.55
7.	India	3.68	32.	Argentina	0.54
8.	United Kingdom	2.37	33.	Turkey	0.53
9.	Indonesia	1.89	34.	Romania	0.52
10.	Italy	1.72	35.	Bulgaria	0.51
11.	Iraq	1.71	36.	Bolivia	0.48
12.	France	1.63	37.	Pakistan	0.46
13.	Canada	1.62	38.	Belgium	0.40
14.	Mexico	1.43	39.	Peru	0.39
15.	Poland	1.16	40.	Yugoslavia	0.36
16.	Australia	1.13	41.	Nigeria	0.35
17.	South Africa	1.12	42.	Egypt	0.34
18.	Spain	1.01	43.	Viet Nam	0.32
19.	Venezuela	1.01	44.	Greece	0.31
20.	Republic of Korea	0.98	45.	Ecuador	0.30
21.	Zaire	0.93	46.	Bangladesh	0.29
22.	Thailand	0.88	47.	Hungary	0.26
23.	Korea, Democratic People's Republic	0.84	48.	Austria	0.25
			49.	Demark	0.24
24.	Islamic Rep of Iran	0.82	50.	Algeria	0.23
25.	Saudi Arabia	0.78			

Greenhouse Index Ranking /Percent Share of Global Emissions, 1991

The table above gives the national rank and percent share on the increase in the atmosphere's warming potential attributed to countries that in 1991 emitted the largest amounts of CO_2, methane and CFCs. The 1991 index uses new estimates by the U. N. Food and Agriculture Organization of annual average deforestation between 1980 and 1990 in calculations of CO_2 emissions. Some countries, like Brazil, rose in rank because of a higher deforestation estimate. Other countries, like India, fell from their 1989 ranking because of lower deforestation estimates and a lower weight given to methane emissions. Because of the oil well fires in Kuwait, which were assigned to Iraq, that country rose from 50th to 11th place in rank.

The per capita rankings are calculated from the ratio of the country's per capita emissions to the world median per capita figure, which for 1991 was 2.59 metric tons of CO_2 equivalent per person. Some countries which appeared high on the list of total emissions, disappear from the list of the highest per capita emitters (China and India for example). The four highest per capita emitters are large producers of oil (Qatar, Gabon, the United Arab Emirates and Brunei) or experienced severe deforestation during the 1980s. Among the industrialized countries, per capita emissions in the United States are 9 times those of China and 18 times those of India, reflecting the great disparities that exist in per capita emissions between industrialized and developing countries.

Objective:

- To analyze greenhouse gas emissions on a global scale;
- To compute the total greenhouse gas emissions for 50 countries;
- To rank countries by their per capita greenhouse gas emissions;

Procedure:

1. Read and study the **Introduction** carefully.

2. Use the information provided on the **Data Table** and your calculator to compute the total greenhouse gas emissions for each country listed.
   - Copy the formula that your teacher put on the board and use it to compute these amounts.
   - Write your answers on the **Data Table.**

3. Rank each country according to its total emissions.
   - Write the rank number in the appropriate space on the **Data Table.**

4. Classify and list each country on the **Data Table** according to the per capita amount:

   Group A- Countries with per person emissions more than twice the global average;
   Group B- Countries with per person emissions between 1 and 2 times the global average;
   Group C - Countries with per person emissions less than the global average;

5. Locate the countries on the world map and color in each location according to these groups:
   - **Group A - Red**
   - **Group B- Blue**
   - **Group C- Yellow**

6. Answer the questions in the **Analysis and Comprehension** section.

Data Table: Countries with the Highest Emissions of Greenhouse Gases, 1991

RANK	COUNTRY	Per Capita	Population (Millions)	Total Emissions	RANK	COUNTRY	Per Capita	Population (Millions)	Total Emissions
	Paraguay	3.04	4.89			Cyprus	3.15	0.74	
	Netherlands	4.66	15.50			New Zealand	4.42	3.39	
	United States	8.95	263.14			Panama	4.13	2.66	
	Suriname	6.63	0.46			Italy	3.53	57.91	
	Belgium	4.76	10.03			Iceland	3.32	0.27	
	Saudi Arabia	5.95	17.61			Iraq	10.84	21.22	
	Israel	3.90	5.88			Norway	5.68	4.36	
	Nicaragua	3.64	4.43			Bolivia	7.68	8.07	
	Czechoslovakia	5.30	15.88			Venezuela	6.01	21.48	
	Qatar	18.63	0.534			Bahrain	8.43	0.29	
	Luxembourg	11.41	0.40			Ecuador	3.23	11.82	
	Trinidad/Tobago	6.53	1.31			Austria	3.88	7.86	
	Finland	4.60	5.05			Libya	3.68	5.41	
	Spain	3.05	39.28			South Africa	3.39	42.74	
	Germany	5.54	81.26			United Kingdom	4.87	58.09	
	Brunei	11.51	0.28			Guyana	3.67	0.83	
	USSR	5.68	288.56			Poland	3.56	38.74	
	Singapore	6.33	2.85			Bahamas	4.00	2.55	
	Switzerland	3.09	6.96			Canada	7.10	6.96	
	Korea, D.P.R.	4.48	23.92			Japan	4.81	125.88	
	Gabon	17.03	1.37			France	3.39	57.77	
	Australia	7.70	18.34			Ireland	4.80	3.47	
	Denmark	5.61	5.19			Bulgaria	6.74	8.89	
	Greece	3.61	10.25			Malaysia	3.93	20.13	
	Brazil	3.37	161.38			U.A. Emirates	16.15	1.79	

Student Activity Sheet #1

Part I: Classify and list the countries below according to their per capita amounts.

Group A	Group B	Group C

Part II: Analysis and Comprehension

1. What do scientists expect to happen if greenhouse gas concentrations continue at their present rate?

_____

_____

2. What short-term event occurred in 1991? _____

_____

3. What could have been the cause for these declines? _____

_____

_____

4. What is the estimate made by the IPCC? _____

_____

_____

Student Activity Sheet #2

5. According to what information are countries listed in the data table in the Introduction? _____

_____

6. Why did Brazil's rank in 1991 change? _____

_____

7. Why did India's rank decrease? _____

_____

8. What caused the rise in Iraq's rank? _____

9. What was the world median per capita figure for 1991? _____

10. Why were some countries that are high on the total emissions table low in the per capita emissions rank? _____

_____

11. How does the U.S. per capita figures compare to those of China and the India ?

_____

_____

12. According to your map, which region of the world appears to be responsible for the largest amount of greenhouse gas emissions? _____

13. Give two possible reasons for such elevated amounts. _____

_____

14. What does the information in #12 tell you about the quality of living in developing countries as compared to countries like the U.S. and the U.S.S.R?_____

_____

_____

15. If developing countries try to better their living conditions, how could the concentrations of greenhouse gases be affected? _____

_____

_____

Teaching Activity: Creating a Greenhouse Gas Index, 1991

Introduction: The impact of human activities on the Earth's climate is under intense scientific study. Human activity is increasing the concentrations of greenhouse gases (carbon dioxide, methane, CFCs, and nitrous oxide) and the trend, if continued, is expected by atmospheric scientists to lead to global climate change with uncertain, but potentially grave long-term effects.

Despite temporary declines in greenhouse gas emissions in 1991 as a result of changes in the growth of the industrial world's energy consumption and the lower estimates of tropical deforestation, the concentrations of greenhouse gases continue to rise. The ***Intergovernmental Panel on Climate Change (IPCC)*** has estimated that an immediate 60 percent reduction in emissions of long-lived gases would be required to stabilize the atmospheric concentrations. As long as concentrations continue rise, so does the warming potential of the atmosphere and hence the risk of global climate change.

Rank	Country	Percent	Rank	Country	Percent
1.	United States	19.14	26.	Czechoslovakia	0.70
2.	Former Soviet Union	13.63	27.	Malaysia	0.61
3.	China	9.92	28.	Colombia	0.61
4.	Japan	5.05	29.	Netherlands	0.59
5.	Brazil	4.33	30.	Philippines	0.59
6.	Germany[a]	3.75	31.	Myanmar	0.55
7.	India	3.68	32.	Argentina	0.54
8.	United Kingdom	2.37	33.	Turkey	0.53
9.	Indonesia	1.89	34.	Romania	0.52
10.	Italy	1.72	35.	Bulgaria	0.51
11.	Iraq	1.71	36.	Bolivia	0.48
12.	France	1.63	37.	Pakistan	0.46
13.	Canada	1.62	38.	Belgium	0.40
14.	Mexico	1.43	39.	Peru	0.39
15.	Poland	1.16	40.	Yugoslavia	0.36
16.	Australia	1.13	41.	Nigeria	0.35
17.	South Africa	1.12	42.	Egypt	0.34
18.	Spain	1.01	43.	Viet Nam	0.32
19.	Venezuela	1.01	44.	Greece	0.31
20.	Republic of Korea	0.98	45.	Ecuador	0.30
21.	Zaire	0.93	46.	Bangladesh	0.29
22.	Thailand	0.88	47.	Hungary	0.26
23.	Korea, Democratic People's Republic	0.84	48.	Austria	0.25
24.	Islamic Rep of Iran	0.82	49.	Demark	0.24
25.	Saudi Arabia	0.78	50.	Algeria	0.23

Greenhouse Index Ranking /Percent Share of Global Emissions, 1991

The table above gives the national rank and percent share on the increase in the atmosphere's warming potential attributed to countries that in 1991 emitted the largest amounts of CO_2, methane and CFCs. The 1991 index uses new estimates by the U. N. Food and Agriculture Organization of annual average deforestation between 1980 and 1990 in calculations of CO_2 emissions. Some countries, like Brazil, rose in rank because of a higher deforestation estimate. Other countries, like India, fell from their 1989 ranking because of lower deforestation estimates and a lower weight given to methane emissions. Because of the oil well fires in Kuwait, which were assigned to Iraq, that country rose from 50th to 11th place in rank.

The per capita rankings are calculated from the ratio of the country's per capita emissions to the world median per capita figure, which for 1991 was 2.59 metric tons of CO_2 equivalent per person. Some countries which appeared high on the list of total emissions, disappear from the list of the highest per capita emitters (China and India for example). The four highest per capita emitters are large producers of oil (Qatar, Gabon, the United Arab Emirates and Brunei) or experienced severe deforestation during the 1980s. Among the industrialized countries, per capita emissions in the United States are 9 times those of China and 18 times those of India, reflecting the great disparities that exist in per capita emissions between industrialized and developing countries.

Objective:

- To analyze greenhouse gas emissions on a global scale;
- To compute the total greenhouse gas emissions for 50 countries;
- To rank countries by their per capita greenhouse gas emissions;

Important Terms: Total emissions, per capita, industrial compounds, deforestation, IPCC, ranking;

Materials: Calculator, pencil/paper, **Student Activity Sheet**, blank world map, colored pencils;

Procedure:

1. Go over the **Introduction** and the **Data Table** of per capita emissions with the class.

2. Tell students that they are going to use the information provided on the **Data Table** to compute the total greenhouse gas emissions for each country listed.
   - Be sure that they understand the difference between per capita and total emissions.

3. Write the following formula on the blackboard:

   Per capita amount x population = Total emissions (millions of metric tons)

   2.25 x 3.75 = 8.4375

4. Students should use the formula to compute the total emissions for the countries listed and write that information in on the **Data Table.**

5. Students should then rank each country according to its total emissions.

6. Students should then classify and list each country on the **Data Table** according to the per capita amount:

   Group A - Countries with per person emissions more than twice the global average;
   Group B - Countries with per person emissions between 1 and 1 times the global average;
   Group C - Countries with the person emissions less than the global average;

7. Students should then locate the countries on the world map and color in each country according to these groups:
   - **Group A - Red**
   - **Blue - Group B**
   - **Yellow - Group C**

8. Instruct students to complete the questions in the **Analysis and Comprehension** section.