

3.3.2 Gas Files Activity

The Gas Files

Teacher Information:

There are 5 greenhouse gases that will be discussed in this activity. Students should have a task card, a recording sheet and the first 4 resource cards. Resource cards 5 and 6 are optional.

More information on greenhouse gases:

Water vapor (H₂O). The most abundant greenhouse gas. It acts as a feedback to the climate. Water vapor increases as the Earth's atmosphere warms, but so does the possibility of clouds and precipitation, making these some of the most important feedback mechanisms to the greenhouse effect.

Carbon dioxide (CO₂). A minor but very important component of the atmosphere (in terms of concentration). Carbon dioxide is released through natural processes such as respiration and volcano eruptions and through human activities such as deforestation, land use changes, and burning fossil fuels. Humans have increased atmospheric CO₂ concentration by more than a third since the Industrial Revolution began. This is the most important long-lived "forcing" of climate change.

Methane (CH₄). A hydrocarbon gas produced both through natural sources and human activities, including the decomposition of wastes in landfills, agriculture, and especially rice cultivation, as well as cattle digestion and manure management associated with domestic livestock. On a molecule-for-molecule basis, methane is a far more active greenhouse gas than carbon dioxide, but also one which is much less abundant in the atmosphere.

Nitrous oxide (N₂O). A powerful greenhouse gas produced by soil cultivation practices, especially the use of commercial and organic fertilizers, fossil fuel combustion, nitric acid production, and biomass burning.

Chlorofluorocarbons (CFCs). Synthetic compounds of entirely of industrial origin used in a number of applications, but now largely regulated in production and release to the atmosphere by international agreement for their ability to contribute to destruction of the ozone layer. CFCs are also greenhouse gases and so are the compounds we have made to replace them .

TASK CARD: The GAS Files

Greenhouse gases are invisible. They are in the atmosphere. They are produced both naturally and because of human activity. We call this either:

NATURAL - caused by nature or **ANTHROPOGENIC**- caused by humans

Using the resource cards as references, DISCUSS the following questions with your group:

1. What are the main greenhouse gases in the atmosphere? According to Resource Card 1, what is the most abundant greenhouse gas?
2. According to Resource Cards 1 and 2, there are many sources of greenhouse gases. On your table, record the 5 main greenhouse gases and give one natural and one human source for each one. These are **SOURCES** for greenhouse gases.
3. What trends do you notice in greenhouse gas emissions over time? (Resource Card 3) Why do you think this is happening?
4. For each of the 4 gases humans release (not counting water vapor), what is one thing that could be done to decrease the amount we are emitting?
5. Where are the major **SINKS** or places to store carbon? Is this natural or caused by humans? Some people are proposing that we capture and store carbon dioxide underground. Do you think this will work? Why? (Resource Card 4)
6. Using at least two graphs, give an example relating the graphs and explaining the evidence scientists use to support climate change.

Name _____ Per _____ Date _____

RECORDING SHEET: The GAS Files

List the main greenhouse gases and at least two sources for each one. Divide the sources by **human** causes (anthropogenic) and **natural** causes. Not all may have both human and natural causes. (Resource Card 1 and 2)

Greenhouse Gas (GHG)	Human Cause - SOURCE	Natural Cause - SOURCE

Using Resource Card 3, what trends do you notice for greenhouse gases over time?

For each of the 4 gases humans release (not counting water vapor), what is one thing that could be done to decrease the amount we are emitting?

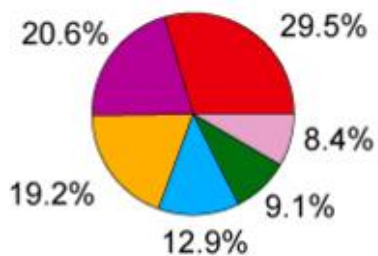
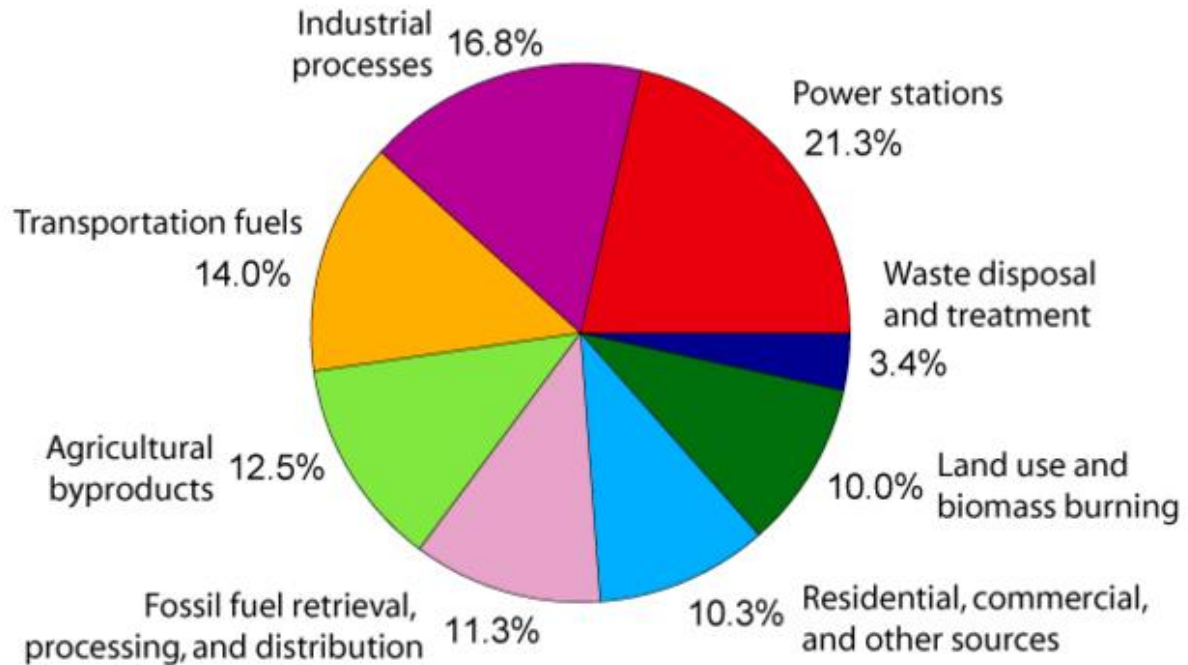
Where are the major SINKS or places to store carbon? Is this natural or caused by humans? Some people are proposing that we capture and store carbon dioxide underground. Do you think this will work? Why? (Resource Card 4)

Explain the emission profiles in Resource Card 5. Why is this important to understand?

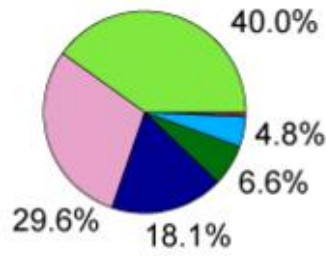
Using at least two graphs, give an example relating the graphs and explaining the evidence scientists use to support climate change.

RESOURCE CARD 1: The GAS Files

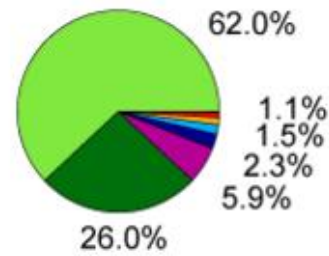
Annual Greenhouse Gas Emissions by Sector



Carbon Dioxide
(72% of total)



Methane
(18% of total)



Nitrous Oxide
(9% of total)

The top pie graph shows the proportion of annual greenhouse emissions from different sources.

The bottom three pie graphs show the breakdown for each of three greenhouse gases in comparison to the total. Seventy two percent (72%) of the total greenhouse gases emitted was carbon dioxide, 18% methane and 9% nitrous oxide. Use the color pattern in the upper pie graph to determine which source is represented in the lower pie graphs.

RESOURCE CARD 2: The GAS Files

Major Greenhouse Gases and their Sources

Greenhouse Gas	Main sources
Water Vapor (H ₂ O)	Water in the air as clouds or vapor
Carbon Dioxide (CO ₂)	Burning fossil fuels, deforestation, land use changes, respiration, volcanic eruption
Methane (CH ₄)	Decomposition of wastes in landfills, agriculture (especially rice production), cattle digestion, manure management
Nitrous Oxide (N ₂ O)	Soil cultivation practices (how we grow plants), use of fertilizers, burning fossil fuels, biomass burning, microbial denitrification
Chloroflorocarbons (CFCs)	Human made compound. Originally made for use as a coolant in refrigerators and air conditioners. Now CFCs are regulated because of international agreements to limit use.

Definitions:

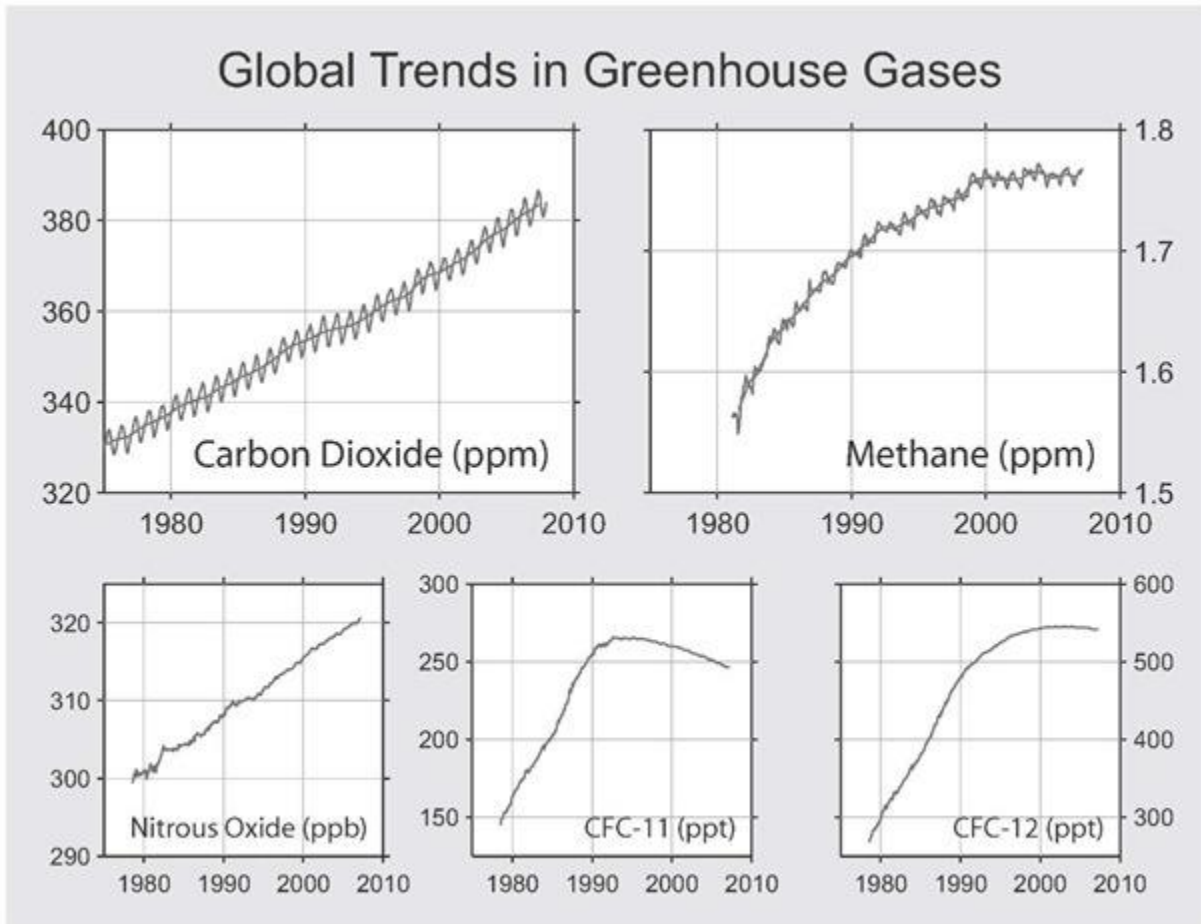
Deforestation – cutting down trees

Land Use Changes – when what is on the land changes. For example, a forest changes into a farming field, a grassy lot changes into a parking lot, a white glacier changes into brown dirt

Decomposition – the breakdown of something into something else

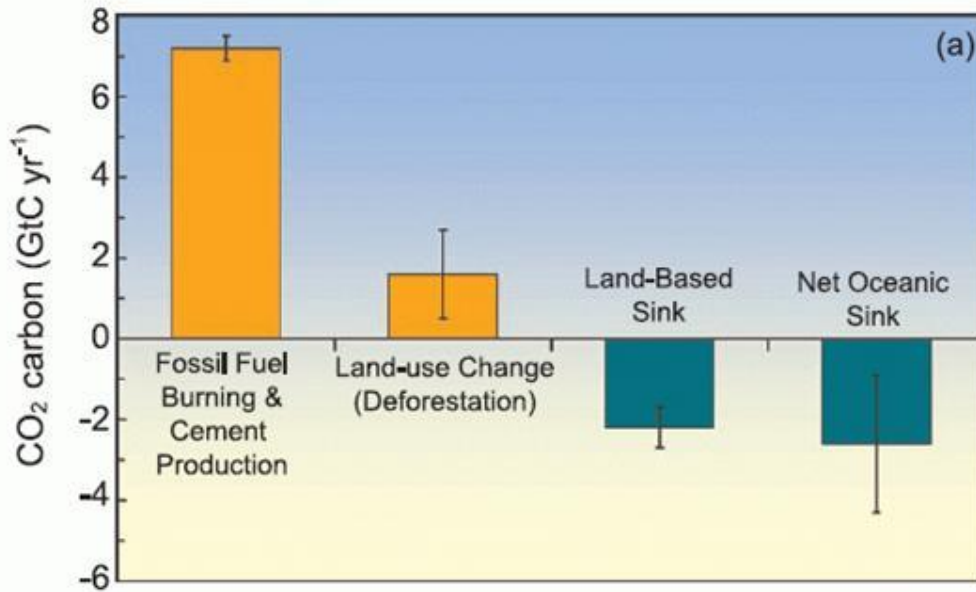
Biomass - plants

RESOURCE CARD 3: The GAS Files



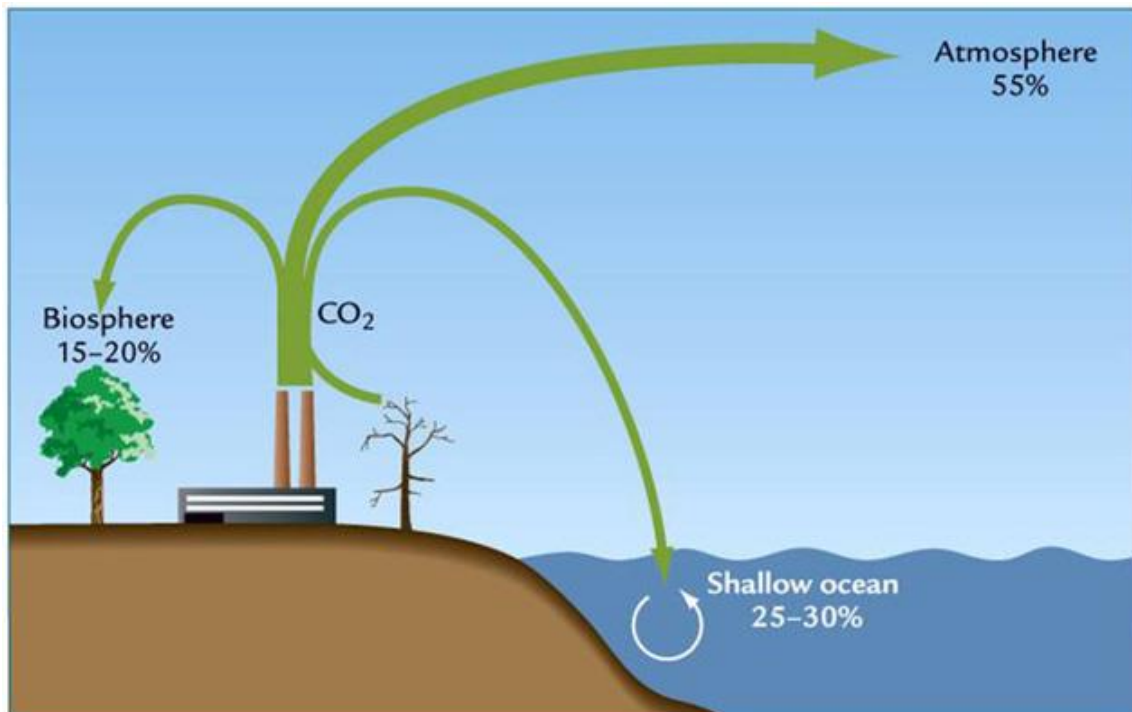
RESOURCE CARD 4: The GAS Files

Amount of Carbon Released or Stored by Different Sources per Year



Where does carbon go?

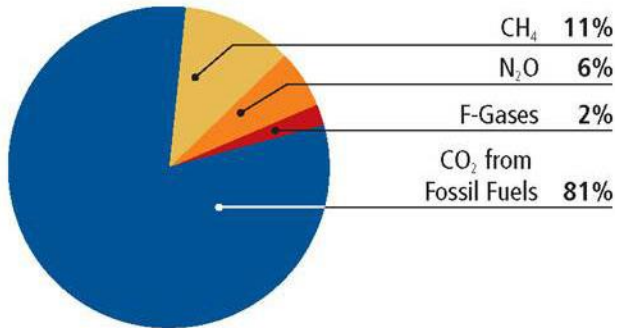
Carbon is released from the respiration of plants and the burning of fossil fuels. It is stored in the atmosphere (the air), the biosphere (plants and soil) and the ocean.



RESOURCE CARD 5: The GAS Files

Emission Profiles by Gas and Source

A. Developed Countries



Key:

CO₂ – Carbon Dioxide

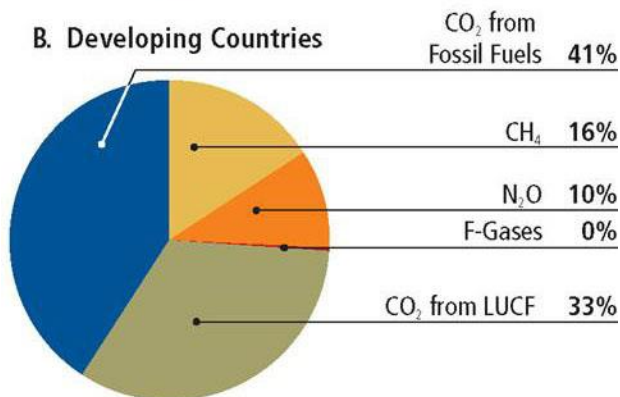
N₂O – Nitrous Oxide

CH₄ – Methane

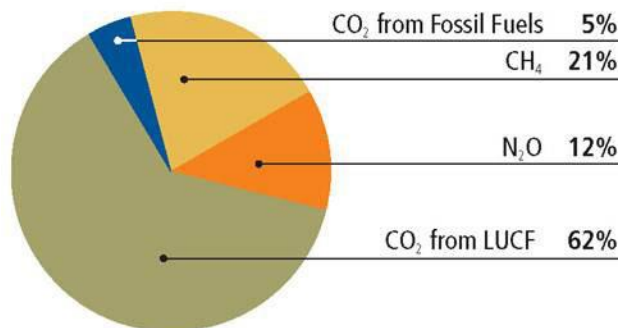
LUCF – Land Use Change and Forestry

F-gases – Chlorofluorocarbons (CFCs)
(man made synthetic chemicals)

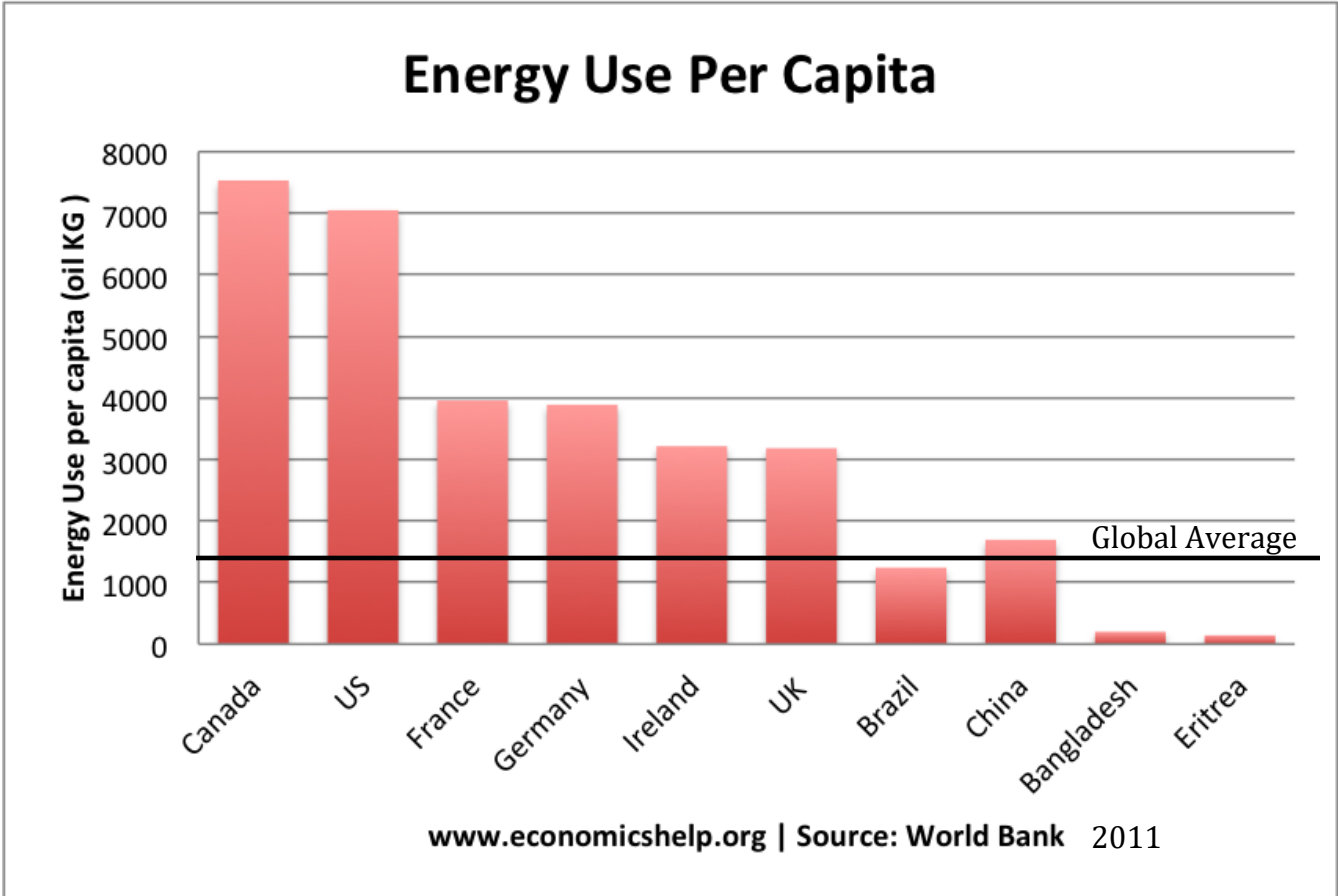
B. Developing Countries



C. Least Developed Countries



RESOURCE CARD 6: The GAS Files



Highest Energy Users per Capita

1Iceland	16404.7
2Trinidad and Tobago	15158.2
3Qatar	14911.1
4Kuwait	11402.1
5United Arab Emirates	8588.0
6Bahrain	8096.3
7Brunei Darussalam	7971.3
8Luxembourg	7934.1
9Canada	7534.0
10North America	7098.5
11United States	7050.6
12Finland	6212.9
13Australia	5970.9
14Saudi Arabia	5888.1
15Norway	5849.3
16Oman	5554.1
17Belgium	5299.7
18Sweden	4883.4
19High income	4853.1
20Netherlands	4729.2