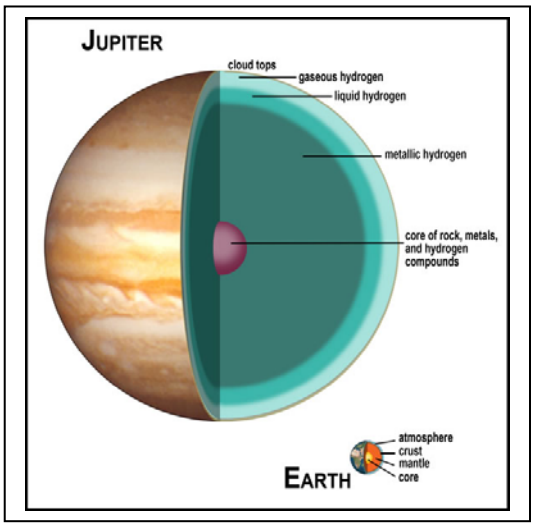

Most of the planets in our solar system have two or three constituents that make up most of the atmosphere. For example, Venus and Mars have more than 98% of their atmosphere in carbon dioxide and nitrogen, while Earth has 99% of its atmosphere in nitrogen and oxygen. But trace gases with percentages below 1% are also important. For example, without the 0.3% of carbon dioxide in Earth's atmosphere, Earth would be a lifeless and frigid planet!

Scientists use 'parts per million' to represent the amounts of trace gases in a planetary atmosphere.

Examples: One year is 1 part per hundred of a century, or 1% of a century.
One year is 1 part per thousand of a millennium, or 0.1% of a millennium.
One millimeter is 1 part per million of 1 kilometer, or 0.0001% of a kilometer.

Problem 1 - The following list gives the percentages of various trace gases in the atmospheres of the indicated objects. Convert these percentages to parts-per-million (ppm) units.

Earth:	Carbon Dioxide……	0.038%.....	_____	ppm
	Neon……....	0.00182%.....	_____	ppm
	Methane…….	0.000175%.....	_____	ppm
	Water Vapor……...	5.0 %.....	_____	ppm
Mars:	Neon……....	0.00025%.....	_____	ppm
	Methane…….	0.00000105%.....	_____	ppm
Titan:	Methane…….	1.4%	_____	ppm
	Argon……....	0.0043%.....	_____	ppm
	Carbon Monoxide…...	0.0052%.....	_____	ppm
	Ethane…….	0.0013%.....	_____	ppm
Jupiter:	Methane…….	0.3%.....	_____	ppm
	Ammonia…….	0.026%.....	_____	ppm
	Ethane…….	0.00058……	_____	ppm
	Water Vapor……...	0.0004……	_____	ppm

Problem 2 - Using your ppm answers from Problem 1, by what factor does Earth have more methane than Mars as a trace gas?

Problem 3 – The amount of carbon dioxide in Earth's atmosphere is increasing by 2.5 ppm per year. If its value in 2012 was measured to be 392 ppm, by what year will it have reached 517 ppm? How old will you be then, if the growth rate continues at this rate of increase?

Problem 1 - The following list gives the percentages of various trace gases in the atmospheres of the indicated objects. Convert these percentages to parts-per-million (ppm) units.
Answer: Example: Earth CO2. 0.038% = 0.00038 then 0.00038 x 1,000,000 = 380 ppm

Earth:	Carbon Dioxide…….	0.038%.....	**380**	**ppm**	
	Neon……....	0.00182%.....	**18.2**	**ppm**	
	Methane…….	0.000175%.....	**1.75**	**ppm**	
	Water Vapor……...	5.0 %.....	**50000**	**ppm**	
Mars:	Neon……....	0.00025%.....	**2.5**	**ppm**	
	Methane…….	0.00000105%.....	**0.0105**	**ppm**	or 10.5 ppb
Titan:	Methane…….	1.4%	**14000**	**ppm**	
	Argon……....	0.0043%.....	**43**	**ppm**	
	Carbon Monoxide…..	0.0052%.....	**52**	**ppm**	
	Ethane……..	0.0013%.....	**13**	**ppm**	
Jupiter:	Methane……..	0.3%.....	**3000**	**ppm**	
	Ammonia…….	0.026%.....	**260**	**ppm**	
	Ethane…….	0.00058……	**5.8**	**ppm**	
	Water Vapor…….....	0.0004……	**4.0**	**ppm**	

Note. When the value for ppm is less than one, use parts per billion by multiplying ppm by 1000. Example, for Mars and Methane, 0.0105 ppm = 0.0105 x1000 = 10.5 ppb.

Problem 2 - Using your ppm answers, by what factor does Earth have more Methane than Mars as a trace gas?

Answer: Earth/Mars = 1.75 ppm/0.0105 ppm = **167 times more than Mars**.

Problem 3 – The amount of carbon dioxide in Earth's atmosphere is increasing by 2.5 ppm per year. If its value in 2012 was measured to be 392 ppm, by what year will it have reached 517 ppm? How old will you be then, if the growth rate continues at this rate of increase?

Answer: To get to 517 ppm from 392 ppm it must increase by 517-392 = 125 ppm. If the increase is 2.5 ppm each year, it will take 125/2.5 = 50 years, so the year will be 2062.
If a student was 15 years old in 2012, they will be 65 years old in 2062.