

## Answer 1

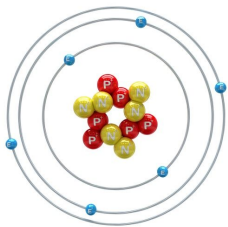
# What is causing climate change?

“The evidence is clear that carbon dioxide (CO<sub>2</sub>) is the main driver of climate change, even as other greenhouse gases and air pollutants also affect the climate.”

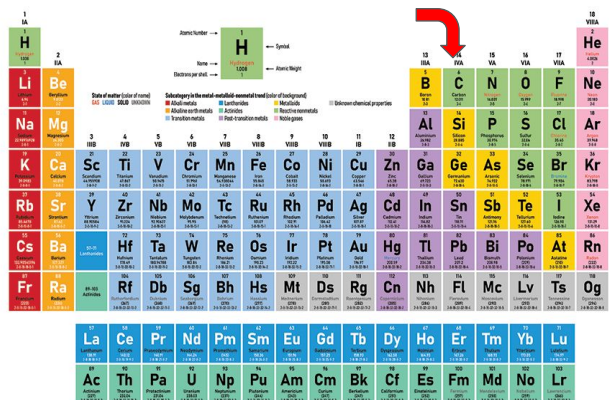
The Intergovernmental Panel on Climate Change (IPCC) is the United Nations body for assessing the science related to climate change

## Answer 2

# Carbon: C



## Periodic Table of the Elements



1 H Hydrogen	2 He Helium																
3 Li Lithium	4 Be Beryllium	5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon										
11 Na Sodium	12 Mg Magnesium	13 Al Aluminum	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon										
19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton
37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon
55 Cs Cesium	56 Ba Barium	57 La Lanthanum	58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium	
87 Fr Francium	88 Ra Radium	89-103 Actinides	104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium	111 Rg Roentgenium	112 Cn Copernicium	113 Nh Nihonium	114 Fl Flerovium	115 Mc Moscovium	116 Lv Livermorium	117 Ts Tennessine	118 Og Oganesson

## Answer 3

# They all contain carbon!



*Coal: 84%  
carbon*

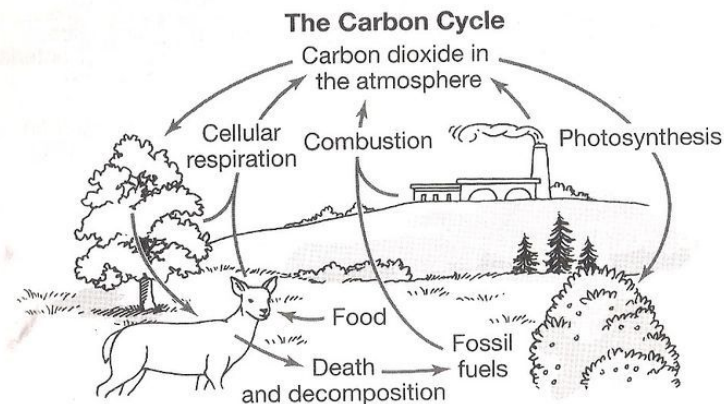


*Plants: 50% carbon  
by dry weight*



*Human beings:  
18.5% carbon by  
mass*

## Answer 4



This is a simplified version of the C cycle. It omits many key processes (oceans, rivers), and does not show the relative contribution to the cycle: **photosynthesis** removes 123 Gt C per year; **respiration** (plants and soil microbes) adds 120 Gt C; **combustion** of fossil fuels adds 6 Gt of C per year.

The link between **death and decomposition** and **fossil fuel** is an example of a very slow process that **take places over millions of years**.

## Answer 5

# Climate change is happening now

“Global climate change has already had observable effects on the environment. Glaciers have shrunk, ice on rivers and lakes is breaking up earlier, plant and animal ranges have shifted and trees are flowering sooner.

Effects that scientists had predicted in the past would result from global climate change are now occurring: loss of sea ice, accelerated sea level rise and longer, **more intense heat waves.**” NASA

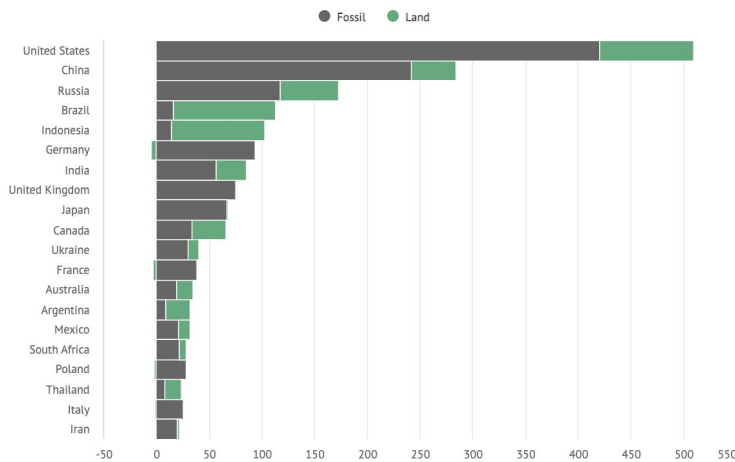
In Uganda, the average temperatures have noticeably increased, other impacts have been difficult to attribute because of the lack of data and high natural variability (e.g. precipitation). However, **Uganda is one of the world’s most vulnerable countries to future climate risk** due to the reliance on rain-fed agriculture and low adaptive capacity to extreme events (lack of insurance schemes, lack of infrastructure, energy poverty and access to risk information and resources for resilience).

## Answer 6

**USA emitted more than 500 000 000 000 tonnes (500 Gt) of CO2 since 1850, and hence bears the most responsibility.**

The countries with the largest cumulative emissions 1850-2021

Billions of tonnes of CO2 from fossil fuels, cement, land use and forestry



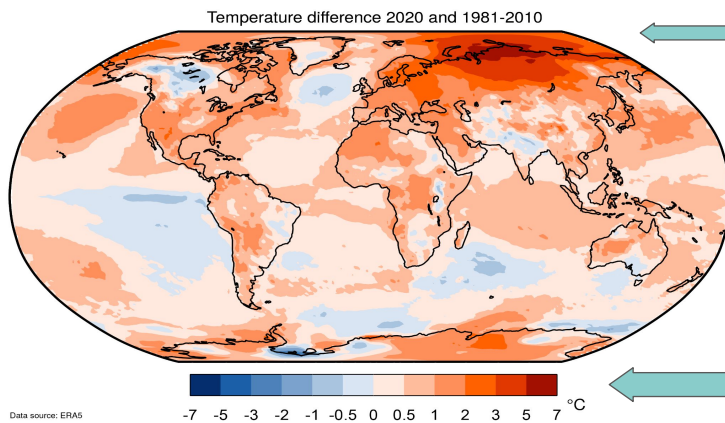
USA, China, Russia, Brazil, and Indonesia are the top 5 emitters of greenhouse gasses since 1850.

South Africa is the only African country among the top **historical** emitters.

Uganda’s **historical** contribution to climate change has been minimal.

## Answer 9

Arctic region is the far north



Data source: ERA5



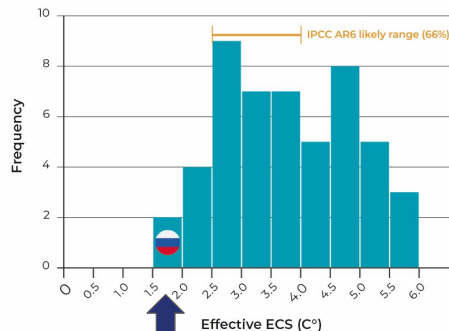
Look at the legend, the strip below the map, dark red colour means the temperature in some parts of the Arctic is more than 5 degrees warmer on average.

## Answer 10

No, the Russian models are least concerned about CO2

EQUILIBRIUM CLIMATE SENSITIVITY (ECS)

IPCC AR6  
CMIP6 climate models



Data compiled by Mark Zelinka.

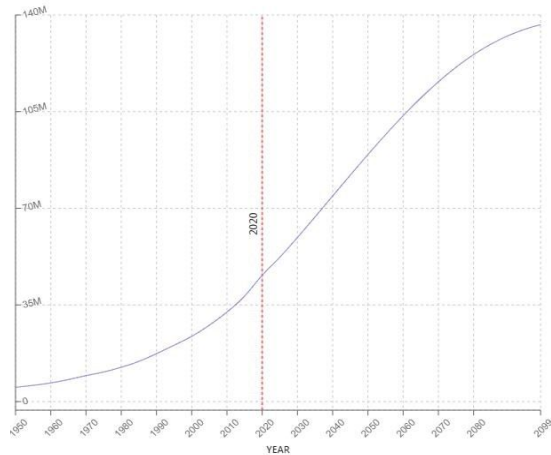
Look at the X-axis, the bar to the left represents Russia's models, and their ECS values are between 1.5 and 2 degrees.

IPCC uses about 50 different climate models, 2 of which are from Russia.

Answer 11

## Population in Uganda

Predicted to reach 100 million in 30 years



Answer 13

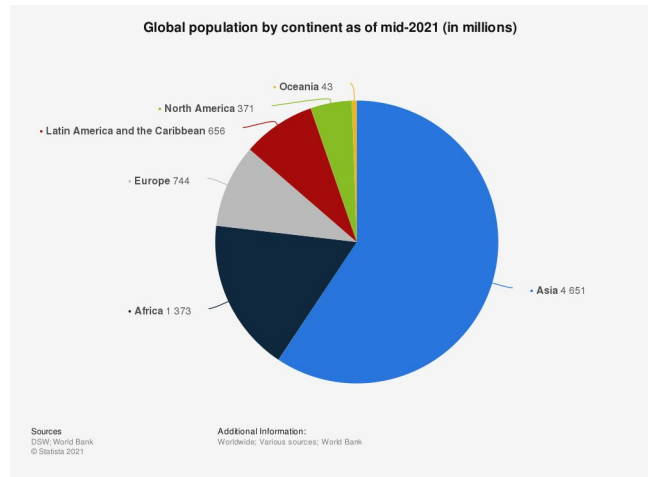
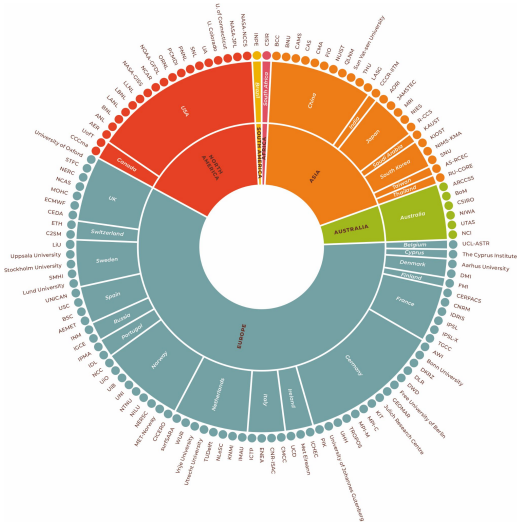
## Numeracy

1 billion tonnes (1 Gt) is the same as  
1000 000 000 000 tonnes or  $10^9$ .

Both carbon C and carbon dioxide  
CO<sub>2</sub> fluxes (exchanges) are  
measured in gigatonnes of Gt.

## Answer 14

**False:** Europe collects more than half the data but it is less than a tenth of the world's population.



## Answer 15

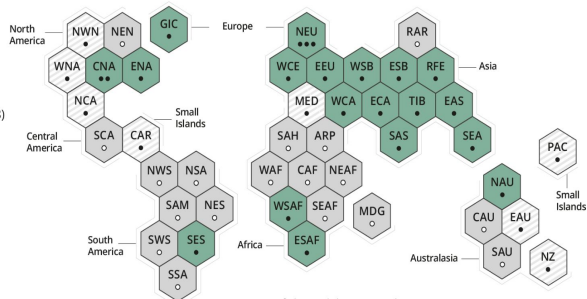
# Reading charts + graphs

Type of observed change in heavy precipitation

- Increase (19)
- Decrease (0)
- Low agreement in the type of change (8)
- Limited data and/or literature (18)

Confidence in human contribution to the observed change

- High
- Medium
- Low due to limited agreement
- Low due to limited evidence



Type of observed change since the 1950s.

**Can't Determine (limited data, low confidence due to limited evidence).** Rain variability from year to year is high in many places and precipitation records are often not detailed or long enough to say with confidence that precipitation increased or decreased in a particular region as a result of human contribution to climate change. North Eastern Europe (NEU) is the only place so far that increases of rain have been attributed to anthropogenic (human caused) influence with high confidence (...).

## Climate: Uganda

### Rains around Kampala are influenced by ...

- ✓ Indian Ocean
- ✓ Pacific Ocean
- ✓ Kampala being a large city
- ✓ Irrigation in India
- ✓ Climate change
- ✓ All of the above

**All of the above.** The conditions in **Indian Ocean** are considered to be **the most influential** on the **timing and intensity of rains** in Uganda, but studies have also shown that the size of the city affects rain patterns nearby or large irrigation schemes as far as India may have also impacts on rain patterns in North East Africa, including Uganda.

## Greenhouse effect

### Answer



**Greenhouse gasses** (water vapor, carbon dioxide, methane, ozone, nitrous oxide, chlorofluorocarbons) act like the glass in the greenhouse - they **trap heat**. **Extra carbon dioxide** means the atmosphere prevents more heat from escaping into space **making the world warmer**.

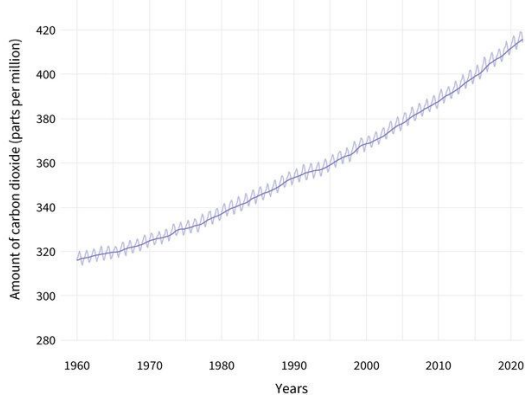


## Answer 18

# Global CO<sub>2</sub> concentration

## Answer

### ATMOSPHERIC CARBON DIOXIDE (1960-2021)



**First clue: the timescale.** Seasonal variability cannot be visible on a graph that spans hundreds of years, so it has to be the graph that spans only decades!

Why does atmospheric carbon dioxide vary between winters and summers? The answer is **photosynthesis**, the largest component of the carbon cycle. There is more land in the north of the globe and so CO<sub>2</sub> spikes in winters when there is less greenery creating the zig-zag pattern on the graph.

## Answer 19

# The Paris Agreement

**“The Paris Agreement is a legally binding international treaty on climate change.** It was adopted by 196 Parties [including Uganda] at COP 21 in Paris, on 12 December 2015 and entered into force on 4 November 2016.

Its goal is **to limit global warming to well below 2**, preferably to 1.5 degrees Celsius, compared to pre-industrial levels.

To achieve this long-term temperature goal, countries aim to reach global peaking of greenhouse gas emissions as soon as possible to achieve a **climate neutral world by mid-century.**” UN



# Climate or weather?

These ones refer to “climate”

- |  |  |                               |
|--|--|-------------------------------|
| 1) Largely tropical, with two rainy seasons    | 2) Tropical savannah, tropical forests and arid steppe | 7) It does not snow in Uganda |
| 5) December to February are the hottest months | 8) 5000 years ago Sahara was green                     | 6) Soon it will be too hot    |

9) “Changes in air temperature, not precipitation, drove the expansion and contraction of glaciers in Africa’s Rwenzori Mountains at the height of the last ice age”

6) “Soon it will be too hot” can be the a reference to climate if “soon” is taken to mean decades, but it is more likely to describe weather if “soon” is understood to be a matter of hours, e.g. “this afternoon”.

It is the opening line of the novel *The Drowned World* by JG Ballard.

