Worksheet CO_2 monitoring

Task 1: What do you think? (the part before the exploration begins)

Before exploration			After exploration	
True	False		True	False
		CO_2 concentration has not changed throughout history.		
		The safe concentration of CO_2 in the atmosphere is 350 ppm (parts per million). The actual concentration will be higher.		
		The CO_2 concentration among the green plants will be higher than outside the plants.		
		The amount of CO_2 absorbed in a tree is less than the total mass of the tree.		

Task 2: What happens to CO_2 in the atmosphere?

Study the infographic *Evolution of CO_2 concentration in the atmosphere* and complete:

- In the last **800 000** years, the CO_2 concentration has fluctuated in the range of _____ ppm, and the fluctuations corresponded to the alternation of glacial and interglacial periods (for comparison: the first records of Homo sapiens are about 300,000 years old).
- Over the last **2000** years, until **1750** CO_2 concentrations have been steadily in the _____ ppm range.
- Since the Industrial Revolution, that is, since about 1750, CO_2 concentrations have been rising rapidly, reaching higher values than at any time in the last 800,000 years. Moreover, the average rate of increase is also accelerating. In **2019**, the CO_2 concentration reached its highest value _____ ppm.

Task 3: How much CO_2 is in the atmosphere today?

Measure the concentration of CO_2 in the atmosphere. Wait 90 seconds before measuring the concentration to allow the readings to settle. Then start the measurement - readings are taken every 4 seconds. After 60 seconds, stop the measurement and record the lowest and highest values in the table.

Concentration of CO_2	Place with no vegetation		Place with vegetation	
	min	max	min	max
ppm				

Task 4: How much CO_2 can a tree store?

Carbon dioxide is stored in trees by the process of photosynthesis. At the same time, they release carbon dioxide into the air through respiration. How much CO_2 is stored in a tree?

To calculate the amount of carbon dioxide in a tree, you need to measure the circumference of the tree at a height of 1.3 m from the ground and find out the height of the tree using e.g. GlobeObserver app.

Tree circumference: **c** = _____ cm

Tree height: **h** = _____ m

Calculate the diameter of the tree: $d = \frac{c}{\pi}$, π=3,14

Tree diameter: **d** = _____ cm

From the calculated diameter, we determine **the green weight** of the tree, which is an estimate of the weight of the tree while it is alive. As you can imagine, weighing a live tree is not feasible. For this reason, foresters use a set of formulas to estimate green weight.

Green weight
For trees with diameter < 28 cm: **GW = 0.0577 x d^2 x h**
For trees with diameter > 28 cm: **GW = 0.0346 x d^2 x h**

Green weight: GW = _____ **kg**

Dry weight represents the mass of the wood in the tree when dried in an oven, so the moisture is removed. On average, experiments have shown that a tree's dry weight is about 50 per cent of its green weight.

DW = GW × 0.5

Dry weight: DW = _____ **kg**

Amount of carbon dioxide that has been absorbed by the tree through it's lifetime:

CO_2 =1,63 x DW

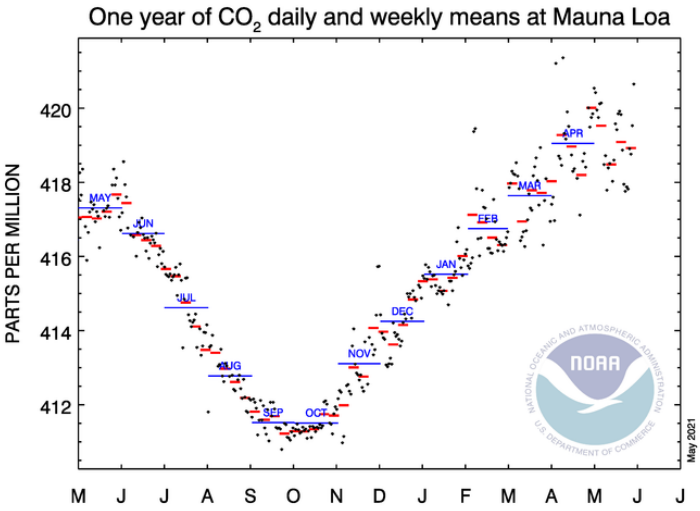
Over its life time the tree has absorbed _____ kg of CO_2 = _____ tonnes

Why is the amount of CO_2 higher than the total mass of the tree? What is the biological significance of this?

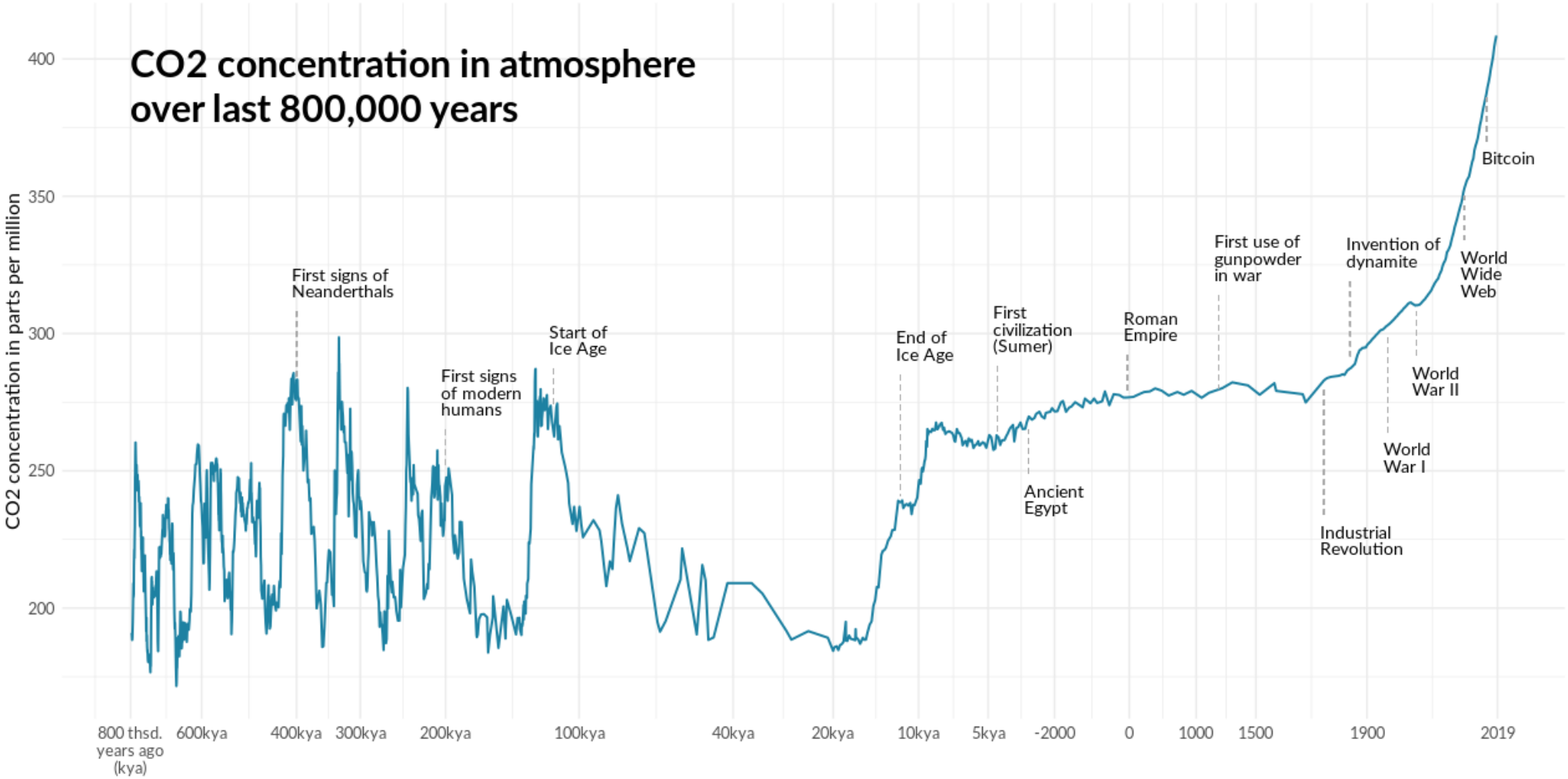
What is the difference in CO_2 released to the atmosphere as we burn the tree or let it rot?

Task 5: What happens to CO_2 during the year?

The concentration of CO2 fluctuates in a regular cycle during the year. It is the highest in May and the lowest in autumn. See the graph showing the average daily values over a one-year period (May 2020-April 2021) as measured at the Mauna Loa Observatory in Hawaii. **What causes the CO_2 concentration in the atmosphere to fluctuate throughout the year?**



Task 6: Were you right? Complete your card from task 1 after the exploration.



Time is warped using sqrt scale before 1900 for readability. Graphic: Gregor Aisch, vis4.net

Source: NOAA (1959-today), NASA (1850-1958), Monnin et al., Petit et al., Siegenthaler et al., Luethi et al. (800kya-1850)