# Moles and Avogadro

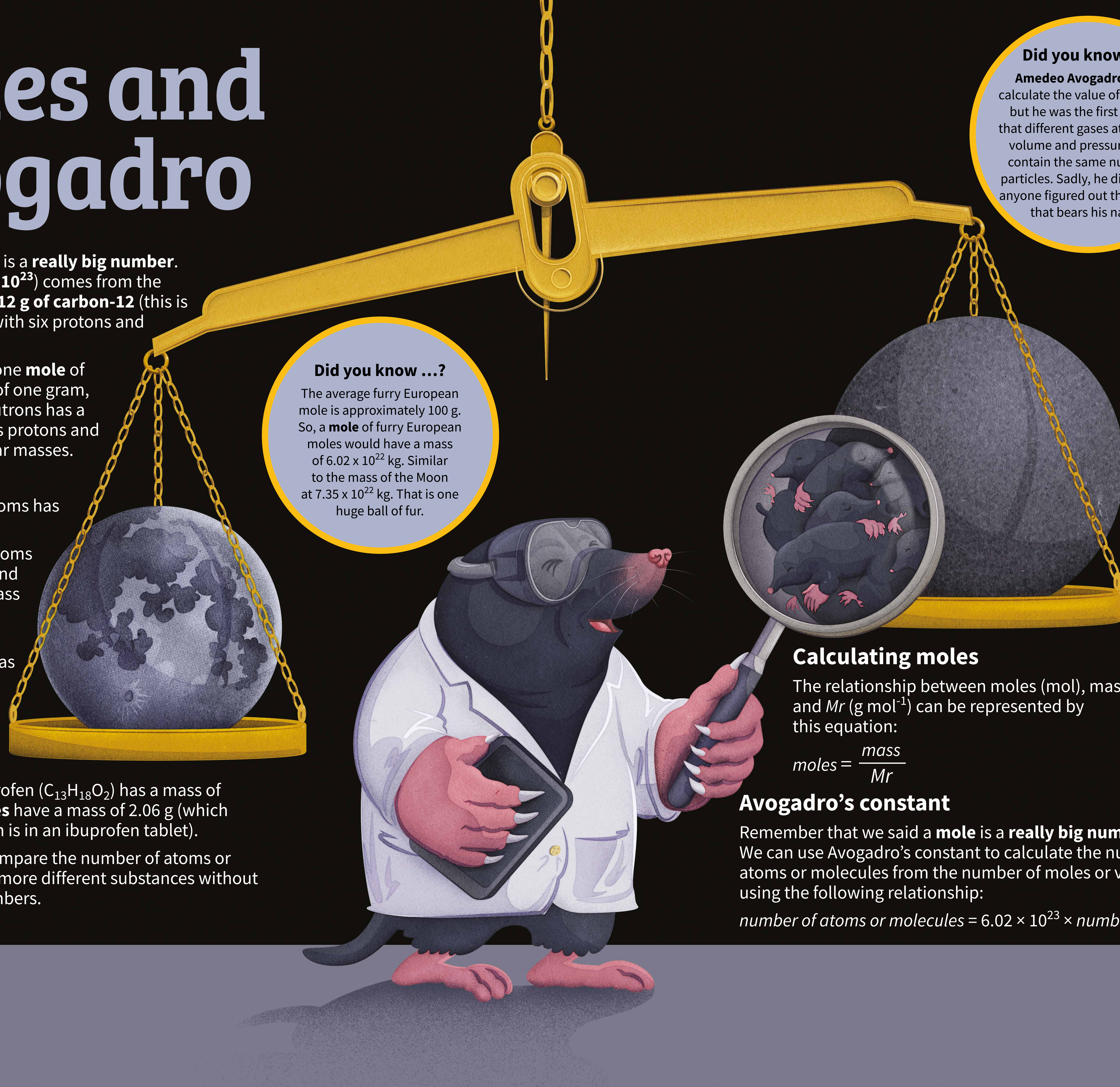
In chemistry, a **mole** is a **really big number**. This number (**$6.02 \times 10^{23}$**) comes from the number of atoms in **12 g of carbon-12** (this is the carbon isotope with six protons and six neutrons).

So, we can say that one **mole** of protons has a mass of one gram, and one **mole** of neutrons has a mass of one gram, as protons and neutrons have similar masses.

This means that:

- One **mole** of $^{1}H$ atoms has a mass of one gram.
- One **mole** of $^{19}F$ atoms has a mass of 19 g, and two moles have a mass of 38 g.
- One **mole** of $NH_3$ molecules – which has a relative molecular mass (*Mr*) of 17 – has a mass of 17 g, and half a **mole** has a mass of 8.5 g.
- One **mole** of ibuprofen ($C_{13}H_{18}O_2$) has a mass of 206 g, and 0.01 **moles** have a mass of 2.06 g (which is still way more than is in an ibuprofen tablet).

**Moles** allow us to compare the number of atoms or molecules in two or more different substances without writing out long numbers.



### Did you know …?

The average furry European mole is approximately 100 g. So, a **mole** of furry European moles would have a mass of $6.02 \times 10^{22}$ kg. Similar to the mass of the Moon at $7.35 \times 10^{22}$ kg. That is one huge ball of fur.

### Did you know …?

**Amedeo Avogadro** didn't calculate the value of the **mole**, but he was the first to claim that different gases at the same volume and pressure would contain the same number of particles. Sadly, he died before anyone figured out the number that bears his name.

## Calculating moles

The relationship between moles (mol), mass (g) and *Mr* (g mol$^{-1}$) can be represented by this equation:

$$moles = \frac{mass}{Mr}$$

## Avogadro's constant

Remember that we said a **mole** is a **really big number** … We can use Avogadro's constant to calculate the number of atoms or molecules from the number of moles or vice versa, using the following relationship:

$$\textit{number of atoms or molecules} = 6.02 \times 10^{23} \times \textit{number of moles}$$



eic
education in chemistry
rsc.li/3OyJ9C6