

How atoms join to make molecules

Grade 8 science (Year 9 · Class 8) · Lab

Name: _____ Date: _____ Class: _____

How can we check a chemical formula by building a model? In this lab you build six molecules from clay and sticks, count their atoms and bonds, and weigh each model to see whether the number of balls agrees with the formula.

Level: Grade 8 science (Year 9 · Class 8) · **Curriculum:** MS-PS1-1

Aim

To build models of six simple molecules, count their atoms and bonds, and check each against its chemical formula.

Equipment

- Modelling clay in four colours (navy or black for carbon, white for hydrogen, red for oxygen, violet or blue for nitrogen)
- About 30 cocktail sticks
- A kitchen balance reading to 0.1 g
- Ruler and paper

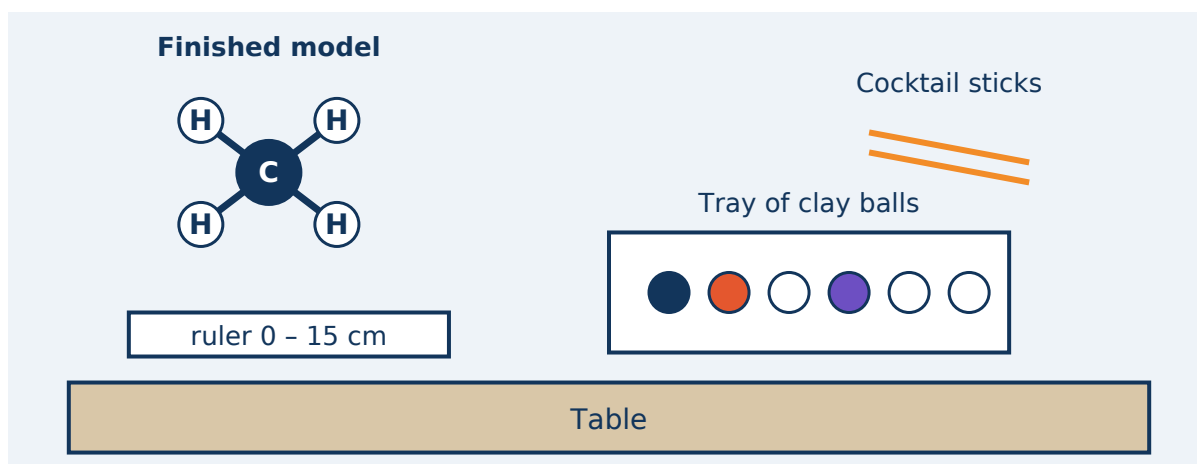
Safety

Safety

Cocktail sticks have sharp ends. Push them in carefully, keep them away from your face and put them in the bin when finished. Wash your hands after handling clay and never put it in your mouth.

Method

1. Roll balls of clay of about equal size, 3 g each. Use the balance to check a few.
2. For each molecule in the table, choose the right number of balls of each colour.
3. Join the balls with sticks: one stick for a single bond, two sticks side by side for a double bond (O_2 and CO_2).
4. Count the balls and the sticks used and record them.
5. Place each finished model on the balance and record its mass.
6. Sketch each model before you take it apart.



Set-up: clay balls in four colours, cocktail sticks and a ruler on a table.

Results

A group in Colombo recorded the sample data below. The balls were about 3 g each.

Molecule	Formula	Balls used	Sticks used	Mass of model (g)
Hydrogen	H ₂	2	1	6.1
Oxygen	O ₂	2	2	6.0
Water	H ₂ O	3	2	9.2
Carbon dioxide	CO ₂	3	4	8.9
Methane	CH ₄	5	4	15.1
Ammonia	NH ₃	4	3	12.0

Analysis questions

Question 1 Atoms from formulas

State how the number of balls used for each molecule can be found from its formula. Check this for CH₄ and NH₃.

Question 2 Mass per ball

Calculate the mass per ball (model mass ÷ balls used) for each molecule, then the mean of the six values.

Question 3 Spread of the results

State the highest and lowest mass per ball and calculate the range. Suggest one reason why the values are not identical.

Question 4 Sticks and valency

Look at the number of sticks touching each atom type in your models. State how many sticks touch carbon, hydrogen, oxygen and nitrogen atoms.

Question 5 Predict ethanol

Ethanol has the formula C_2H_6O . Predict the number of balls and of sticks you would need and the mass of the model if balls are 3.0 g.

Question 6 Limits of the model

Describe two ways in which your clay models are different from real molecules.

Question 7 Improving the lab

Suggest two improvements that would make the mass measurements more reliable.