

STRAW MOLECULAR MODELS



1. Objectives

To learn how to make simple molecular models using colour plastic straws

1 group must make 1xH₂, 1xH₂O, 1xO₂, 1xN₂, 1xNH₃, 1xCO₂ and 1x CH₄ models

2. Materials and tools (for 10 groups / 1 class)

37 pairs of scissors, rulers, 24cm long and 5mm diameter colour flexible plastic straws, 6mm diameter plastic straws, explanation sheets, score sheets

Straw set for one group

1x orange straw (hydrogen)

3x green straws (carbon)

6x yellow straws (nitrogen and joint)

5x purple straws (oxygen)

4x 16mm long and 6mm diameter straw pieces

3. Covalent radii

When making molecular models, it is important to express relative distance between atoms as accurate as possible. We are going to use covalent radii (table 1) as distances between atoms. In order not to waste resources we should make big models or small models. It is up to the length and quality of the straws we can buy. If you want to make big molecular models you can multiply each covalent radius by 6.4×10^8 . If you want to make small models, multiply 4.4×10^8 .

Table 1. Some Covalent radii

Element	H	C	N	O	F	Cl	Br	I	
Covalent radius (pm= 10^{-12} m)	37	77	74	73	71	99	114	133	
Length of straw (mm)	big model	24	49	48	47	46	64	74	86
	small model	16	34	32	32	31	44	50	59

Table 2. Combinations of straw and element

Element	H	C	N	O
number of arm(s)	1	4	3	2
colour of straw	orange	pale green	yellow	purple
Photo				

4. How to make a joint

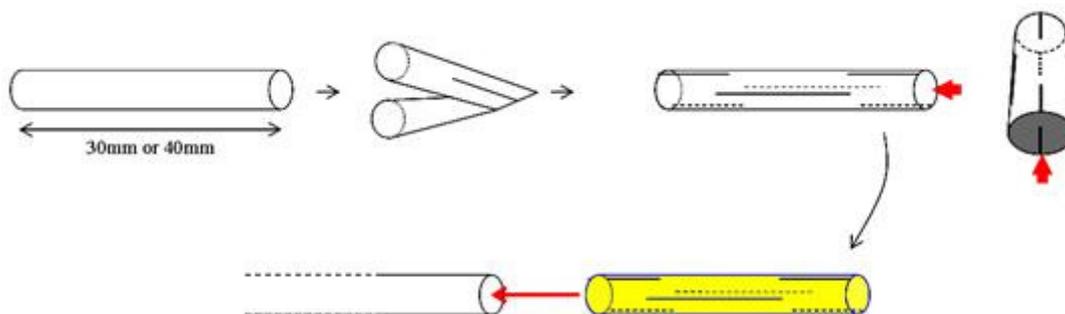


Figure 1. (How to make a joint)

Cut out 40mm (or 30mm for small size models) white or pale colour straw piece. Fold the piece and make a cut like the folded side picture above. Straighten the straw and make short cut on both ends which are orthogonal to previous slits. You can connect open straw ends with these connectors (joints) without any glue or adhesive tapes.

5. Samples of small molecules

H ₂	H ₂ O	O ₂	N ₂	NH ₃
				

6. Activities

- 1) Make the following atom models using colour straws.
(2+2+3+4)×hydrogen, (1+2+2)×oxygen, 3×nitrogen, 2×carbon
- 2) Make the following small molecules
a hydrogen molecule, a water molecule, an oxygen molecule, a nitrogen molecule, an ammonia molecule, a carbon dioxide molecule, a methane molecule



Students were making models



Pasted waste bags on the lab table before the lesson

If students have enough time, they can move on to 6. 3).

- 3) Select one molecule from the list below and make its straw model. Students must not select same molecule from their group mates.

Methanol (CH_3OH), Ethanol ($\text{CH}_3\text{CH}_2\text{OH}$), Acetic acid (CH_3COOH), Ammonium ion (NH_4^+), Ethane (CH_3CH_3), Ethylene (C_2H_4 , $\text{CH}_2=\text{CH}_2$), Formaldehyde (HCHO), Acetaldehyde (CH_3CHO), Acetone (CH_3COCH_3), Glycine $\text{H}_2\text{NCH}_2\text{COOH}$

7. Evaluation

Appearance, structural stability, proper measurement of straw length