Covalent bonding

Student activity • desk activity

YEAR 10 / LESSON 22 / CHEMISTRY + SCIENCE (DOUBLE AWARD)

The question

How can shared electron pairs explain single, double and triple covalent bonds?

Construct outer-electron dot-and-cross diagrams, count shared and lone pairs, then explain covalent bonding in terms of electrostatic attraction. Models represent electron accounting, not coloured electrons or fixed paths. This is a paper modelling activity with no chemicals.

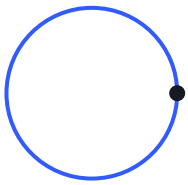
Equipment

- Student booklet, pencil and two distinguishable dot/cross symbols
- Periodic table and blank paper for larger diagrams
- Optional per pair: 24 counters in two colours or pencil dots/crosses instead

Desk activity only. No chemical samples or live reactions. Keep counters out of mouths and return loose pieces; use pencil symbols instead if preferred.

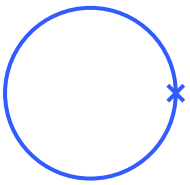
Course coverage: 1.44–1.46: shared electron pairs, electrostatic attraction, and dot-and-cross diagrams for the specified simple molecules and up-to-two-carbon organic examples.

Model key • count every electron



H

One outer electron



H

One outer electron

Starting atoms, outer electrons only. Redraw after sharing; put the shared pair between the nuclei.

Method and reasoning

Read the whole sequence before starting

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1. Start with hydrogen. Place one outer electron from each H atom between two nuclei; count one shared pair and two electrons around each H. Explain that both nuclei attract the shared pair.

2. Draw Cl_2 and HCl. Show all outer electrons, including lone pairs, using dots and crosses to identify origins. Count two electrons around H and eight around Cl.

3. Draw H_2O, NH_3 and CH_4. Count the shared pairs and any lone pairs on O, N or C. Check every atom, not just the central one.

4. Draw O_2, N_2 and CO_2. Use two shared pairs for a double bond and three for a triple bond; include remaining lone pairs.

5. Build C_2H_6 and C_2H_4, then one halogenated example CH_3CH_2Cl. Check carbon makes four bonds and each hydrogen one. Use adjacent-atom symbol conventions consistently.

6. Complete the table and annotate one diagram with the attraction between positive nuclei and a shared negative electron pair. Do not draw ionic brackets/charges on these neutral molecules.

7. Explain one limitation of the two-dimensional dot-and-cross model. A bond line may summarise a shared pair, but a requested dot-and-cross diagram must show the electrons.

Cleanup

• Keep evidence and corrections together. Return shared cards/counters and equipment; close the recording or reference pages. No chemical waste is generated.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Outer-electron counts: H 1, C 4, N 5, O 6, halogens 7. Each shared pair counts towards the outer shell of both bonded atoms. In these examples H has two outer electrons after bonding, and C/N/O/halogens have eight. Dot and cross symbols show origin only; all electrons have the same charge. Use extra paper for the larger molecules.

Molecule	Shared pairs / bonds	Lone pairs to show
H_2 / HCl		
H_2O / NH_3		
O_2 / N_2		
CO_2 / CH_4		
C_2H_6 / C_2H_4		
CH_3CH_2Cl		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

YEAR 10 / LESSON 22 / CHEMISTRY + SCIENCE (DOUBLE AWARD)

1. Define a covalent bond and explain the electrostatic attraction involved.

2. Draw complete outer-electron dot-and-cross diagrams for H_2 and HCl.

3. Draw H_2O and NH_3, showing lone pairs.

4. Draw O_2, N_2 and CO_2 and identify double and triple bonds.

5. Draw CH_4, C_2H_6, C_2H_4 and CH_3CH_2Cl. Check the number of bonds at each carbon.

6. Correct: “A covalent bond transfers one electron and the dots are positive electrons.” Give one model limitation.