CHEMDU · COMMUNITY CHEMISTRY · LEVEL 1

LECTURE 3

Chemical Bonding

Stick Together or Die Alone: Why Atoms Hold Hands

■ Duration: 50 minutes

Lecture script · with hooks, segments, demos, and key takeaways

Hook (opening 3 minutes)

Teacher holds up (or shows photos of):

A glass of water and a bottle of cooking oil

A non-stick frying pan (Teflon coated)

A magnet

Teacher says: "Water and oil don't mix. That's why your salad dressing separates. Non-stick pans don't stick to food — but eggs still stick to stainless steel. Magnets stick to some metals but not to wood."

- "Today's question: What makes things stick together — or refuse to stick? *

By the end of this session, you will be able to:

Explain why water is called the 'universal solvent'

Tell someone why mixing bleach and ammonia creates deadly gas (using what you know about bonds)

Understand why some poisons need special cleaners to remove from skin"

SEGMENT 1: Why Do Atoms Bond at All? (7 minutes)

Teacher says: "Atoms are like people. Some are happy alone. Most want a partner. The reason: electrons."

Quick review (1 minute): "From last week: electrons are negative (-) and live outside the nucleus. Atoms want their outer electron shell to be full — either completely empty or completely full. A full shell = stable and happy."

Draw or show this simple diagram:

text

Sodium (Na) Chlorine (Cl)

11 electrons 17 electrons

1 outer electron 7 outer electrons

Na: "I want to GET RID of my 1 outer electron"

Cl: "I want to GAIN 1 more electron to have 8"

Teacher continues: "When sodium gives its electron to chlorine, two things happen:

Sodium becomes positively charged (Na■)

Chlorine becomes negatively charged (Cl■)

Opposite charges attract. They stick together. That's an ionic bond. And that's how table salt is made."

Phvsical action:

"Extend your right hand (positive) and your left hand (negative). Now pull them together. That's an ionic bond."

SEGMENT 2: Three Types of Bonds — The "Handshake" Analogy (10 minutes)

Teacher says: "There are three main ways atoms stick together. Think of them like different kinds of handshakes."

Show this table (read aloud and act out each one):

Bond Type	Handshake Analogy	Example	Strength
Ionic	One person gives the other a gift → both are charged → magnetic attraction	Table salt (NaCl)	Strong
Covalent	Two people hold hands and share a ball (electron)	Water (H■O), oxygen gas (O■)	Very strong
Metallic	A group hug where all electrons float freely among all atoms	Copper wire, gold jewelry	Strong and flexible

Teacher demonstrates each (using hands):

Ionic: Left hand offers a coin to right hand → hands clasp (opposites attract)

Covalent: Two fists together, rolling a marble (shared electron) between them

Metallic: All students stand in a circle, holding hands loosely, electrons (imaginary balls) passing freely

Quick check (show of hands): "Raise your hand if you can name ONE example of a covalent bond." (Water, oxygen, carbon dioxide) "Raise your hand if you can name ONE example of an ionic bond." (Salt, calcium chloride in de-icers)

SEGMENT 3: The Most Important Bond for Your Life — Water's "Stickiness" (10 minutes)

Teacher says: "Water is H■O — two hydrogens covalently bonded to one oxygen. But here's the magic: water molecules are polar. One end is slightly negative (oxygen side) and one end is slightly positive (hydrogen side)."

Draw or show a water molecule with + and - ends (like a Mickey Mouse head).

Teacher continues: "Because water is polar, it sticks to itself (that's surface tension — why water bugs walk on it) and to other polar things. That's why water dissolves sugar and salt (both polar/ionic)."

Demonstration (live or video description):

> *"Oil is non-polar. Water doesn't stick to oil. That's why oil floats on water and why you need soap to wash greasy dishes."*

Show this table (life applications):

Property	Why It Happens	Real-World Example
Water dissolves salt/sugar	Polar water attracts charged ions	Making tea or soup
Oil and water separate	Oil is non-polar, water is polar	Salad dressing — shake to mix, then it separates
Water climbs up a paper towel	Cohesion (water sticks to itself) + adhesion (water sticks to paper)	Capillary action — how plants drink
Water beads up on a waxy car	Water is more polar than wax, so it prefers to stick to itself	Rain on a freshly waxed car

> Partner talk (1 minute): "Tell your partner: Why does dish soap remove grease from a pan, but water alone cannot?"

Answer (teacher reveals): "Soap has two ends. One end is polar (sticks to water). The other end is non-polar (sticks to grease). Soap acts like a bridge — one hand holds water, the other hand holds grease."

SEGMENT 4: Safety Segment — Bonds That Can Kill You (8 minutes)

> Teacher says: "Now let's apply bonding to life safety. Remember bleach and ammonia from the periodic table lecture? Here's why they're deadly — using bond chemistry."

Scenario: Bleach (sodium hypochlorite) + Ammonia (NH■)

Teacher draws or shows:

text

Bleach + Ammonia → Chloramine gas (NH■Cl) + other toxic gases

> Teacher explains: "The atoms rearrange their bonds and create a new molecule — chloramine gas. It attacks your lungs. This is not 'more cleaning power.' This is chemical warfare in your bathroom."

Safety rule (repeat together as a class): "Never mix bleach with anything except water."

Another example (2 minutes): "Remember sodium metal (alkali metal) and water? That reaction is so violent because the ionic bond in water breaks, hydrogen gas is released, and the heat ignites it. That's

why lithium batteries can catch fire — they contain pure lithium (alkali metal) in a small space."

What to do if a lithium battery catches fire:

Do NOT use water (it makes it worse)

Use a Class D fire extinguisher (made for metal fires) or sand

Evacuate the area

> Partner talk (1 minute): "Describe to your partner one dangerous chemical reaction you should never try at home."

SEGMENT 5: The "Poison on Your Skin" Problem (6 minutes)

> Teacher says: "Imagine you spill gasoline (non-polar) on your hand. You wash with water. Nothing happens — because water is polar and gasoline is non-polar. They don't stick to each other."

What to do:

Use soap (the bridge) or

Use a small amount of cooking oil to dissolve the gasoline, THEN wash with soap

Another example: "Oil-based paints, pesticides, and some poisons are non-polar. Water alone won't remove them. You need a non-polar cleaner (like rubbing alcohol, soap, or specialized cleaner)."

Actionable rule: "Read the label of a poison or chemical spill. If it says 'oil-based' or 'non-polar', do NOT rely on water alone. Use soap, alcohol, or the specific cleaner recommended."

> Quick poll (show hands): "Raise your hand if you've ever tried to wash grease off your hands with just water — and it didn't work."

Teacher: "Now you know why. Water and oil don't bond. That's chemistry."

SEGMENT 6: Why Non-Stick Pans Work — and When They Become Dangerous (4 minutes)

> Teacher says: "Teflon (non-stick coating) is made of carbon and fluorine — a very strong covalent bond called a C-F bond. It's so strong that almost nothing sticks to it. That's why eggs slide off."

Safety alert: "If you overheat a Teflon pan above 500°F (260°C), the bonds can break and release toxic fumes. Never leave an empty non-stick pan on high heat. Birds are especially sensitive — they can die from the fumes."

What to use instead:

Cast iron (once seasoned — oil molecules bond to the surface)

Stainless steel (requires oil or butter)

Ceramic (safer non-stick alternative)

CLOSING — The 30-Second Challenge (4 minutes)

Teacher says: "Pair up. Person A: 30 seconds — name the three bond types and give one example of each. Person B: 30 seconds — explain why water doesn't remove oil and what you should use instead."

Final takeaway table (show on screen / read aloud):

You learned…	So you can…
Ionic bonds = electron transfer (salt)	Understand why opposites attract
Covalent bonds = electron sharing (water, oxygen)	Explain why molecules form
Metallic bonds = free-floating electrons (copper, gold)	Understand why metals conduct electricity
Water is polar — oil is non-polar	Never wash oil/grease/poison with only water
Bleach + ammonia = bond rearrangement → deadly gas	Never mix cleaning products
Teflon has super-strong bonds — heat can break them	Avoid overheating non-stick pans

Final line (preview of next week): "Next week: Chemical Reactions. You'll learn how to spot a dangerous reaction before it happens — and what to do if you see one. See you then."

SUPPLEMENTARY MATERIALS FOR LECTURE 3 (No Grade)

Resource	Source	Description	Link / Search Term
PhET "Molecule Shapes" simulation	University of Colorado	Build molecules and see polarity	Search "PhET Molecule Shapes"
Video: "Ionic vs Covalent Bonds"	Khan Academy	7-minute overview	YouTube search "Khan Academy ionic covalent"
Video demonstration: Bleach + ammonia	Safety demonstration (never do at home)	Shows why mixing is deadly	Search "bleach ammonia reaction safety video"
Article: "Why Oil and Water Don't Mix"	ACS ChemMatters	Free readable article	ACS.org search "oil and water chemmatters"
Teflon safety fact sheet	Environmental Protection Agency	Safe use of non-stick cookware	Search "EPA nonstick pan safety"

OPTIONAL "NO-PRESSURE" ASSIGNMENT

"Between now and next session, find something in your home that requires soap or a special cleaner to remove (examples: grease on a pan, gasoline smell on hands, paint on skin). Next time, tell us: why wouldn't water alone work?"