CHEMDU · COMMUNITY CHEMISTRY · LEVEL 1

LECTURE 4

Chemical Reactions

The Warning Signs: How to Spot a Dangerous Reaction Before It's Too Late

■ Duration: 50 minutes

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

Hook (opening 3 minutes)

Teacher holds up (or shows photos of):

A rusty bicycle chain (oxidation)

A cut apple turning brown (oxidation)

A fire extinguisher (reaction stopper)

A smoke alarm (reaction detector)

Teacher says: "Every day, thousands of chemical reactions happen around you. Some are helpful — like cooking food or charging your phone. Some are neutral — like rust forming on a fence. And some are deadly — like the wrong two cleaning products mixing in a closed bathroom.

- Today's question: How can you tell the difference before someone gets hurt? *

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

Spot the five warning signs of a dangerous chemical reaction

Know what to do if you see them

Explain why some reactions happen slowly (rust) and some happen instantly (explosion)"

SEGMENT 1: What Is a Chemical Reaction? (6 minutes)

Teacher says: "A chemical reaction happens when atoms rearrange their bonds to make new substances. The stuff you start with (reactants) is different from the stuff you end with (products)."

Show this simple equation (draw or screen):

text

Reactants Products

↓ ↓

Paper (cellulose) + Oxygen → Ash + Carbon Dioxide + Water + Heat

(you can read it) (completely different)

Teacher continues: "You cannot unbake a cake. You cannot unburn a match. That's because chemical reactions are permanent changes at the molecular level."

Quick check (show of hands / chat): "Raise your hand if you can think of a chemical reaction you saw today." (Answers might include: cooking, digestion, rust, battery draining, plant growing)

Physical action: "Pretend your hands are atoms. Clap them together (bond). Now pull them apart (break bonds). Now clap with a different partner (new bond). That's a chemical reaction."

SEGMENT 2: The Five Warning Signs of a Dangerous Reaction (10 minutes)

Teacher says: "Not all reactions are dangerous. But if you see ANY of these five things, something may be wrong — and you may need to evacuate or call for help."

Show this table (read aloud and discuss each one):

Warning Sign	What It Looks Like	Example	Is This Always Bad?
1. Unexpected Heat or Cold	Container gets hot or cold without a flame/fridge	Battery swelling and heating up	No — hand warmers are designed to heat
2. Gas Bubbles (Not Boiling)	Fizzing, foaming, or bubbling without heat	Baking soda + vinegar	No — but if you didn't expect it, be cautious
3. Color Change	Liquid turns brown, black, or an unexpected color	Bleach + ammonia → yellow-green gas (chlorine)	YES — this is often a danger sign
4. Smoke or Fumes	Vapor, mist, or smoke rising	Overheated oil in a pan	YES — evacuate if smoke is not from cooking
5. Unusual Odor	Sharp, bleach-like, rotten egg, or sweet chemical smell	Natural gas leak (rotten egg smell added)	YES — leave immediately

Partner talk (2 minutes): "Share with your partner: Have you ever seen any of these warning signs at home or work? What happened?"

Teacher circulates (or listens for one example to share with the group).

Safety rule (repeat together): "See a sign? Get behind the line. Don't touch. Don't smell. Call for help."

SEGMENT 3: Fast vs. Slow — The Reaction Speed Danger Scale (10 minutes)

Teacher says: "Some reactions take years. Rust takes years. Some take milliseconds — like an explosion. The speed of a reaction is called its rate."

Draw or show this scale on screen:

text

SLOW ←----------→ FAST

Rust Food spoilage Match Fireworks Explosion

(years) (days) (sec) (millisec) (microsec)

Teacher continues: "What controls reaction speed? Four things:

Temperature — heat speeds up reactions (why food spoils faster in summer)

Concentration — more molecules = more collisions (why pure oxygen makes fires burn hotter)

Surface area — smaller pieces = faster reaction (why dust explodes in grain elevators)

Catalyst — something that speeds up a reaction without being used up (enzymes in your body)"

Real-world safety examples:

Factor	Safe Example	Dangerous Example
Temperature	Refrigerating leftovers slows spoilage	Hot car + aerosol can = explosion risk
Concentration	Diluting bleach with water makes it safer	Using full-strength industrial cleaners indoors
Surface area	Grinding spices releases flavor	Grain dust in a silo can explode
Catalyst	Catalytic converter in a car cleans exhaust	Manganese in some fireworks causes unpredictable burning

Quick poll (show hands): "Raise your hand if you've ever left food out overnight and wondered if it's still safe to eat."

Teacher: "Now you know: warmer temperature = faster bacterial growth (bacteria are chemical reactions too). When in doubt, throw it out — especially rice, meat, and dairy."

SEGMENT 4: The Bleach + Ammonia Deep Dive — What Actually Happens (8 minutes)

Teacher says: "We've mentioned this before. Now let's understand it using reaction chemistry."

Show or draw this simplified reaction:

text

Bleach (sodium hypochlorite) + Ammonia

↓

Chloramine gas (NH■Cl) + other toxic gases

↓

Attacks lungs → coughing, burning, fluid in lungs → can kill

Teacher explains step by step:

"Bleach and ammonia are both cleaners. Alone, they're safe if used correctly."

"When they mix, their atoms rearrange bonds to form new molecules — including chloramine gas."

"Your lungs have water on their surface. Chloramine gas reacts with that water to form acid. That acid burns your lung tissue."

"Symptoms may not start for hours — but damage begins immediately."

What to do if you accidentally mix them:

Step	Action
1	Get out — leave the area immediately
2	Open windows if safe to do so from outside
3	Call Poison Control: 1-800-222-1222
4	Do NOT go back in until it's been aired out (hours)
5	Seek medical help if you have trouble breathing, coughing, or burning eyes/throat

Partner talk (1 minute): "Tell your partner: Why should you never mix bleach with anything except water?"

Answer (teacher reveals): "Bleach reacts with acids (vinegar), ammonia (window cleaner), and many other household products to create toxic gases. The only safe dilution is with plain water."

SEGMENT 5: The "Reaction or Not?" Game (8 minutes)

Teacher says: "I'll describe a situation. You decide if it's a chemical reaction — and if it's dangerous. Raise your hand for 'reaction' or 'not a reaction' — then I'll ask for dangerous or not."

Scenario	Chemical Reaction?	Dangerous?	Why
Ice melting in a glass	■ No (physical change — water same molecules)	No	Molecules unchanged; just changed state
Toaster burning bread	■ Yes	Mild — smoke alarm may trigger	New molecules (carbon, smoke) formed
A nail rusting in the rain	■ Yes	No (slow, harmless)	Iron + oxygen + water → rust
Mixing bleach and toilet cleaner (acid)	■ Yes	YES — LEAVE IMMEDIATELY	Chlorine gas released
A lithium battery swelling and hot	■ Yes	YES — evacuate	Internal short circuit → thermal runaway

Scenario	Chemical Reaction?	Dangerous?	Why
Cutting an apple and it turning brown	■ Yes	No (just oxidation — still safe to eat)	Apple enzymes react with air
Your stomach digesting food	■ Yes	No (you want this)	Enzymes break down food

Teacher: "Notice: Many reactions are harmless or helpful. The dangerous ones usually have multiple warning signs — heat + gas + smell + color change all at once."

Key rule (repeat together): "If you didn't intend the reaction, treat it as suspicious."

SEGMENT 6: The "Slow Killer" — Carbon Monoxide (5 minutes)

Teacher says: "Some dangerous reactions are invisible. Carbon monoxide (CO) is a gas produced when fuels burn incompletely — gas stoves, cars, furnaces, fireplaces, generators."

Why it's dangerous:

No smell, no color, no taste

Binds to your blood 200x stronger than oxygen

You fall asleep and don't wake up

What you must do:

Install a carbon monoxide detector on every floor of your home (especially near bedrooms)

Never run a generator inside a garage or near a window

Never warm up a car in a closed garage

If your CO alarm sounds: go outside, call 911, do not re-enter

Quick poll (show hands): "Raise your hand if you have a carbon monoxide detector in your home."

Teacher: "If you don't, they cost $20–40 at any hardware store. That's cheaper than a hospital visit. Get one this week."

CLOSING — The 30-Second Challenge (4 minutes)

Teacher says: "Pair up. Person A: 30 seconds — list three warning signs of a dangerous reaction. Person B: 30 seconds — explain what to do if you mix bleach and ammonia by accident."

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

You learned…	So you can…
Five warning signs: heat, gas, color change, smoke, odor	Spot danger before it's too late
Temperature, concentration, surface area, catalysts control reaction speed	Understand why some things explode and some rust

You learned…	So you can…
Bleach + ammonia = chloramine gas (lung damage)	Never mix cleaning products
Carbon monoxide is invisible and deadly	Install CO detectors; never run engines indoors
If you didn't intend the reaction, treat it as suspicious	Evacuate and call for help

Final line (preview of next week): "Next week: Stoichiometry — The Math-Light Version. No, you don't need to be a mathematician. You just need to understand ratios: why 'just a little more' of a chemical can be deadly, and how recipes (cooking and chemistry) are the same thing. See you then."

SUPPLEMENTARY MATERIALS FOR LECTURE 4 (No Grade)

Resource	Source	Description	Link / Search Term
Video: "5 Signs of a Chemical Reaction"	FreeSchool / YouTube	3-minute video for beginners	Search "5 signs of chemical reaction"
PhET "Reactants, Products, and Leftovers"	University of Colorado	Interactive simulation of chemical reactions	Search "PhET reactants products leftovers"
Poison Control fact sheet: Bleach + Ammonia	poison.org	Official guidance on what to do	Search "poison control bleach ammonia mix"
Carbon monoxide safety video	CDC / YouTube	2-minute public safety announcement	Search "CDC carbon monoxide safety"
Article: "The Chemistry of Rust"	ACS ChemMatters	Readable explanation of slow oxidation	Search "ChemMatters rust chemistry"

OPTIONAL "NO-PRESSURE" ASSIGNMENT

"Between now and next session, check your home for a carbon monoxide detector. If you don't have one, look up the price at a hardware store website (just look — no need to buy). Next time, tell us: did you find one?"