

CHEMDU · COMMUNITY CHEMISTRY · LEVEL 1

LECTURE 5

Stoichiometry

The Recipe Rule: Why "Just a Little More" Can Kill You

■ Duration: 50 minutes

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

Hook (opening 3 minutes)

Teacher holds up (or shows photos of):

A baking recipe card (cookies or bread)

A pool chlorine test kit

A medicine dosing cup

A bleach bottle with dilution instructions

Teacher says: "Imagine you're baking cookies. The recipe says 2 cups of flour. You decide to use 4 cups instead. What happens? You get thick, dry, terrible cookies — but you don't die.

Now imagine you're adding chlorine to a swimming pool. The instructions say 1 cup. You add 3 cups instead. Someone swims in that water. What happens? Chemical burns, lung damage, possibly a trip to the hospital.

- Today's question: Why do some chemicals require exact ratios — and others don't? *

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

Understand why 'more is not better' with pool chemicals, bleach, and medicine

Explain the difference between a recipe (safe to double) and a chemical reaction (dangerous to change)

Identify products in your home that require precise mixing"

SEGMENT 1: What Is Stoichiometry? (No Math Required Definition) (6 minutes)

Teacher says: "Stoichiometry (say: stoy-kee-AH-muh-tree) is a big scary word that just means measuring the right amounts for a chemical reaction.

Think of it as a recipe. A recipe tells you:

How much flour

How much sugar

How many eggs

What temperature

How long to bake

If you change the amounts, you change the cookies.

Chemistry is the same. If you change the amounts, you might change:

Whether the reaction happens at all

How fast it happens

Whether it creates dangerous byproducts

Whether it explodes"

Show this simple analogy (draw or screen):

Recipe (Cookies)	Chemical Reaction (Pool Chlorine)
2 cups flour	1 cup chlorine
1 cup sugar	10,000 gallons water
2 eggs	(no eggs!)
350°F for 12 min	Mix and wait 1 hour
Double it? Works fine	Double it? Someone gets hurt

Quick poll (show hands): "Raise your hand if you've ever doubled a cookie recipe and it turned out fine."

Teacher: "That works for cookies because the ingredients are forgiving. But pool chlorine, bleach, battery acid, and medicine are not forgiving. That's why stoichiometry matters for your safety."

Physical action: "Pretend you're pouring a liquid from one cup to another. Now pretend you're measuring exactly one scoop — not two, not half. That's stoichiometry in action."

SEGMENT 2: The Danger of "Just a Little More" — Three Real Examples (12 minutes)

Teacher says: "Let me show you three situations where 'just a little more' turns safe into deadly."

Example 1: Pool Chlorine

Amount of Chlorine (per 10,000 gallons)	Result
1 cup (correct)	Safe swimming — kills bacteria
2 cups (double)	Eye and skin irritation
3 cups (triple)	Chemical burns, breathing problems
5 cups	Call poison control — do not enter water

Why? "Chlorine is a strong oxidizer. It reacts with water to create acids. More chlorine = more acid = burns your skin and lungs. The safe range is narrow — too little and bacteria grow, too much and you get hurt."

Example 2: Bleach and Water (Dilution)

Mixture (per 1 gallon water)	Safety Level
1/3 cup bleach (correct for disinfection)	Safe — kills germs on surfaces
1 cup bleach	Strong fumes — ventilate area

Mixture (per 1 gallon water)	Safety Level
2 cups bleach	Dangerous fumes — leave room
Undiluted bleach on skin	Chemical burn

What you should do:

Always measure bleach when diluting — do not guess

Never mix bleach with anything except water

If you spill concentrated bleach on skin: rinse for 15 minutes

Example 3: Medicine (Liquid Ibuprofen for Children)

Weight of Child	Correct Dose	Double Dose
24 lbs (11 kg)	1.875 mL	3.75 mL
36 lbs (16 kg)	2.5 mL	5.0 mL

What happens with double dose?

Stomach pain, nausea, vomiting

In extreme cases: liver damage, kidney failure

This is why medicine cups have lines — they're stoichiometry tools

Partner talk (2 minutes): "Share with your partner: Have you ever seen anyone 'eyeball' a medicine dose or a cleaning product? What happened?"

Teacher (after listening): "Eyeballing works for spaghetti sauce. It does NOT work for pool chlorine, bleach, or medicine. That's the main rule of this lecture."

SEGMENT 3: Why Can You Double a Cookie Recipe But Not a Chemical Reaction? (8 minutes)

Teacher says: "This is the key question. Let me explain with limiting reactants — another scary term for a simple idea."

Show or draw this analogy:

text

COOKIES:

2 cups flour + 1 cup sugar + 2 eggs → 24 cookies

If you double the flour but not the eggs:

- You get dry, crumbly cookies
- But they're still cookies (not poison)

text

POOL CHLORINE:

1 cup chlorine + 10,000 gallons water → safe pool

If you double the chlorine but not the water:

- You get a dangerous pool
- People can get chemical burns

Teacher explains: "In chemistry, the limiting reactant is the ingredient that runs out first. In cookies, if you run out of eggs, you just get different cookies. In pool chlorine, if you run out of water, you get dangerous concentration.

Some reactions are forgiving (cookies, lemonade). Some reactions are unforgiving (chlorine, battery acid, medicine). The difference is: unforgiving reactions directly harm your body if the ratio is wrong."

Quick check (show of hands): "Raise your hand if you can name ONE unforgiving chemical (one that requires exact measurement)." (Pool chlorine, bleach, medicine, battery acid, pesticides, antifreeze)

SEGMENT 4: The "What's in Your Home?" Safety Audit (8 minutes)

Teacher says: "Let's do a quick safety audit of common household products. For each one, I'll tell you: can you eyeball it, or do you need to measure exactly?"

Show this table (read aloud and discuss):

Product	Can You Eyeball?	Why?
Laundry detergent	Yes (roughly)	Too much = waste, not danger
Pool chlorine	NO — measure exactly	Too much = chemical burns
Bleach for cleaning	NO — measure	Fumes can harm lungs
Medicine for child	NO — use dosing tool	Overdose = organ damage
Salt for cooking	Yes	Too much = bad taste, not ER visit (unless health condition)
Pesticide spray	NO — follow label exactly	Overdose = poison risk
Fertilizer for lawn	Yes (roughly)	Too much = burned grass, not human harm (unless ingested)
Antifreeze (coolant)	NO — measure with funnel	Too strong/weak = engine damage + toxicity risk

Partner talk (2 minutes): "Pick two products from this table that require exact measurement. Tell your partner WHY they're dangerous if you guess."

Teacher circulates, then shares one good example with the group.

Safety rule (repeat together): "If the product says WARNING, DANGER, or POISON on the label — measure it exactly. No eyeballing."

SEGMENT 5: The "Pool Chemical Disaster" Case Study (6 minutes)

Teacher says: "Let me tell you about a real thing that happens every summer: people adding too much chlorine to pools — or worse, mixing different pool chemicals."

Scenario: "Someone buys granular pool shock (calcium hypochlorite). The label says: 'Add 1 pound per 10,000 gallons.' They don't measure — they dump in 3 pounds. Then they add liquid chlorine on top because 'more is better.'

What happens?

The water becomes dangerously acidic

Chlorine gas rises off the surface

Swimmers start coughing and their eyes burn

Pool has to be closed for days — water drained and refilled"

What to do if you're at a pool and smell strong chlorine (not normal pool smell):

Get out of the water immediately

Move upwind (away from the smell)

Tell a lifeguard or pool manager

If you have trouble breathing, seek medical attention

The "normal pool smell" myth: "That 'chlorine smell' you associate with pools? It's not chlorine. It's chloramine — a gas created when chlorine reacts with sweat, urine, and body oils. More chloramine smell = more contaminants in the water, not more chlorine."

Quick poll (show hands): "Raise your hand if you've ever thought a strong pool smell meant 'lots of chlorine — must be clean.'"

Teacher: "Now you know: strong smell = dirty pool, not clean pool. Clean pool has almost no smell."

SEGMENT 6: The Medicine Dosing Safety Stop (4 minutes)

Teacher says: "Medicine is stoichiometry for your body. Too little = doesn't work. Too much = organ damage or death."

Three rules for medicine safety:

Rule	Why
1. Use the dosing tool that comes with the medicine	Kitchen spoons are not accurate — a teaspoon from your drawer can be 2x too big or small
2. Know the difference between mL, teaspoon, and tablespoon	1 tablespoon = 3 teaspoons = 15 mL. Mix them up and you triple the dose
3. Never guess a child's dose	Children's bodies are smaller — a small error can be an overdose

What to do if you think someone took too much medicine:

- Call Poison Control: 1-800-222-1222 (free, confidential, 24/7)*

Have the medicine bottle in hand

Do NOT wait for symptoms

Partner talk (1 minute): "Tell your partner: Why shouldn't you use a kitchen spoon to measure liquid medicine?"

Answer: "Kitchen spoons vary widely. A 'teaspoon' from your drawer might hold 2.5 mL to 7 mL — not the 5 mL it's supposed to be. That's the difference between a safe dose and an overdose for a small child."

CLOSING — The 30-Second Challenge (4 minutes)

Teacher says: "Pair up. Person A: 30 seconds — name two household products that require exact measurement and explain why. Person B: 30 seconds — explain why you can double a cookie recipe but not a pool chlorine dose."

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

You learned...	So you can...
Stoichiometry = measuring the right amounts for chemical reactions	Never guess when safety matters
Some reactions are forgiving (cookies); some are unforgiving (pool chemicals, medicine)	Know which products require exact measurement
Chlorine in pools: too much = chemical burns	Measure pool chemicals carefully; never mix
Medicine dosing tools matter — kitchen spoons are not accurate	Use the correct measuring device
Strong pool smell = chloramine = contamination, not cleanliness	Recognize a dirty pool and get out
If you're unsure, call Poison Control	1-800-222-1222 — free and confidential

Final line (preview of next week): "Next week: Solutions & Solubility. You'll learn why water alone won't remove grease, how to read concentration labels, and why 'like dissolves like' could save your skin from a poison spill. See you then."

SUPPLEMENTARY MATERIALS FOR LECTURE 5 (No Grade)

Resource	Source	Description	Link / Search Term
Pool chemical safety video	CDC / YouTube	3-minute overview of safe pool chemical handling	Search "CDC pool chemical safety"
Medicine dosing for parents	FDA / YouTube	How to use dosing tools correctly	Search "FDA liquid medicine dosing"
PhET "Reactants, Products, and Leftovers"	University of Colorado	Interactive simulation showing limiting reactants (no math required)	Search "PhET reactants leftovers"
Poison Control fact sheet: Pool chemicals	poison.org	What to do if pool chemical exposure occurs	Search "poison control pool chlorine"
Dilution calculator (optional, for curious students)	Various (free)	Shows how concentration changes with volume	Search "chemical dilution calculator"

OPTIONAL "NO-PRESSURE" ASSIGNMENT

"Between now and next session, find ONE product in your home that has a WARNING label and requires exact measurement (examples: pool chlorine, bleach, pesticide, medicine, antifreeze). Look at the label. Notice the specific ratio (e.g., '1 cup per 10,000 gallons' or '5 mL for 24 lbs'). Next time, tell us: what product and what was the ratio?"