

CHEMDU · COMMUNITY CHEMISTRY · LEVEL 1

LECTURE 7

Acids & Bases

The pH Rule: Why Mixing Bleach and Vinegar Can Kill You — And How Red Cabbage Could Save Your Life

■ Duration: 50 minutes

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

Hook (opening 3 minutes)

Teacher holds up (or shows photos of):

A lemon (acid)

A bottle of bleach (base)

A baking soda box (base)

A vinegar bottle (acid)

Red cabbage (natural pH indicator)

Teacher says: "Lemon juice tastes sour. Bleach feels slippery. Vinegar stings a cut. Baking soda fizzes with acid."

These are all acids and bases. Alone, many are safe. But mix the wrong ones — like bleach and vinegar — and you create a deadly gas that can kill you in minutes.

- Today's question: What are acids and bases — and which mixtures will hurt you? *

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

Tell whether a household product is an acid or a base using a simple test

Know which two cleaning products should never be mixed

Treat an acid spill OR a base spill safely at home"

SEGMENT 1: What Are Acids? (6 minutes)

Teacher says: "Let's start with acids (ASS-ids)."

An acid is a substance that donates (gives away) hydrogen ions (H^+). In simple terms: acids make things sour or sharp-tasting.

Everyday examples you already know: *

| Acid | Where You Find It | Taste / Feel |
|-------------------|------------------------------------|---|
| Citric acid | Lemons, limes, oranges | Sour |
| Acetic acid | Vinegar | Sharp, tangy |
| Lactic acid | Sour milk, yogurt, sourdough bread | Tangy |
| Ascorbic acid | Vitamin C tablets, oranges | Sour |
| Hydrochloric acid | Your stomach (digests food) | Very strong — burns skin |
| Sulfuric acid | Car batteries | Extremely strong — burns skin instantly |

Teacher continues: "Not all acids are dangerous. The acid in lemons is safe to eat. The acid in a car battery can burn through your skin and melt cloth.

The difference is strength and concentration (how much acid is in the water)."

Quick poll (show hands): "Raise your hand if you've ever eaten a lemon or a sour candy."

Teacher: "You ate an acid. That's safe because it's a weak acid at low concentration."

Physical action: "Pretend your hand is giving away a coin (hydrogen ion). That's what an acid does — it gives."

SEGMENT 2: What Are Bases? (6 minutes)

Teacher says: "Now let's talk about bases (BAY-sez).

A base is a substance that accepts (takes) hydrogen ions. In simple terms: bases feel slippery or soapy and taste bitter (never taste unknown bases — some are poisonous).

Everyday examples you already know: *

| Base | Where You Find It | Feel / Taste |
|---------------------|-------------------------------|-------------------------------|
| Sodium bicarbonate | Baking soda | Powder, slightly bitter taste |
| Sodium hydroxide | Drain cleaner, oven cleaner | Very slippery — burns skin |
| Ammonia | Window cleaner, glass cleaner | Sharp smell, slippery feel |
| Calcium hydroxide | Lime water, some antacids | Chalky, bitter |
| Magnesium hydroxide | Milk of magnesia (antacid) | Chalky, bitter |

Teacher continues: "Bases are the opposite of acids. If an acid gives away hydrogen ions, a base takes them. When an acid and a base mix, they neutralize each other — they cancel out."

Everyday example of neutralization: * "You have heartburn (too much stomach acid). You take an antacid like Tums (a base). The base neutralizes the acid. The burning stops."

Quick poll (show hands): "Raise your hand if you've ever taken a Tums or an antacid for heartburn."

Teacher: "That's acid-base chemistry inside your own body."

Physical action: "Pretend your other hand is taking a coin (hydrogen ion). That's what a base does — it takes."

Partner talk (1 minute): "Tell your partner: What's one example of an acid you know? One example of a base?"

SEGMENT 3: The pH Scale — Measuring How Acidic or Basic Something Is (8 minutes)

Teacher says: "Scientists use a scale called pH (PEE-aitch) to measure whether something is an acid or a base.

pH stands for "potential of hydrogen." It's a number from 0 to 14 that tells you how acidic or basic something is.

Show or draw this scale:

text

0----1----2----3----4----5----6----7----8----9----10----11----12----13----14

↑↑↑

Strongest acid Neutral Strongest base

(Battery acid) (Pure water) (Drain cleaner)

Teacher explains:

| pH Number | What It Means | Example | Safe to Touch? |
|-----------|----------------------------|-----------------------------------|--------------------------|
| 0-2 | Very strong acid | Battery acid | NO — burns instantly |
| 3-4 | Strong acid | Lemon juice, vinegar | Maybe — brief contact OK |
| 5-6 | Weak acid | Coffee, soda, rainwater | Yes (except eyes) |
| 7 | Neutral (not acid or base) | Pure water | Yes |
| 8-9 | Weak base | Baking soda in water, toothpaste | Yes |
| 10-11 | Strong base | Milk of magnesia, ammonia cleaner | Careful — can irritate |
| 12-14 | Very strong base | Bleach, drain cleaner | NO — burns skin |

Memorization trick (repeat together): "Low pH = acid (0-6). High pH = base (8-14). 7 is neutral water."*

Quick check (show of hands): "Raise your hand if lemon juice (pH 2) is an acid or a base?" (Acid)
 "Raise your hand if bleach (pH 13) is an acid or a base?" (Base) "Raise your hand if pure water (pH 7) is an acid or a base?" (Neither — neutral)

SEGMENT 4: The Deadly Mix — Bleach + Vinegar (12 minutes)

Teacher says: "Now we get to the safety rule that could save your life.

- Bleach is a strong base (pH ~13). Vinegar is an acid (pH ~2-3). When you mix an acid and a base, they normally neutralize into salt and water.*

But bleach is special. Bleach contains chlorine. When you mix bleach with an acid (vinegar, lemon juice, or any acid cleaner), you create chlorine gas — a yellow-green gas that attacks your lungs."

Show or draw this simplified reaction:

text

Bleach (base) + Vinegar (acid) → Chlorine gas (deadly) + Water + Salt

Teacher continues: "Chlorine gas was used as a weapon in World War I. Soldiers choked to death on it. In your home, mixing bleach and vinegar creates the same gas in your bathroom, kitchen, or laundry room.

Here is what the gas does to your body:

| Time After Exposure | Symptoms |
|---------------------|--|
| Seconds to minutes | Burning eyes, throat, nose |
| Minutes | Coughing, chest tightness, trouble breathing |
| Minutes to hours | Fluid fills your lungs (pulmonary edema) |
| Hours | Can lead to respiratory failure and death |

What other products should NEVER mix with bleach?

| Product | Contains | Creates |
|----------------------------|--|---|
| Vinegar (acid) | Acetic acid | Chlorine gas |
| Ammonia | Ammonia (base, but reacts with bleach) | Chloramine gas (also deadly) |
| Lemon juice | Citric acid | Chlorine gas |
| Toilet bowl cleaner (acid) | Hydrochloric or phosphoric acid | Chlorine gas |
| Rubbing alcohol | Isopropyl alcohol | Chloroform (knocks you out + hurts liver) |

Teacher: "The only safe thing to mix with bleach is plain water. Never mix bleach with anything else."

What to do if you accidentally mix bleach and vinegar (or bleach and ammonia):

| Step | Action |
|------|---|
| 1 | Get out immediately — leave the room, close the door behind you |
| 2 | Open windows from outside if possible |
| 3 | Call Poison Control: 1-800-222-1222 |
| 4 | Do NOT go back in until the room has been aired out for hours |

| Step | Action |
|------|--|
| 5 | Seek medical help if you have trouble breathing, coughing, or burning eyes |

Partner talk (2 minutes): "Tell your partner: Name two things you should never mix with bleach. What gas do they create?"

Answer: Vinegar and ammonia. Vinegar + bleach = chlorine gas. Ammonia + bleach = chloramine gas.

Safety rule (repeat together as a class): "Bleach mixes with water. Bleach mixes with NOTHING else."

SEGMENT 5: How to Test pH at Home — Red Cabbage Indicator (6 minutes)

Teacher says: "You don't need a lab to tell if something is an acid or a base. You can use red cabbage."

A pH indicator (IN-dih-kay-ter) is a substance that changes color depending on whether it's in an acid or a base.

Red cabbage contains a natural pH indicator called anthocyanin (an-tho-SY-uh-nin).

How to make it (simple instructions):

| Step | What to Do |
|------|--|
| 1 | Chop up some red cabbage |
| 2 | Boil it in water for 10 minutes |
| 3 | Strain out the cabbage — keep the purple water |
| 4 | Let it cool |

Now test household liquids:

| Liquid | Color Turns | Acid or Base? |
|----------------------|--------------------|----------------|
| Lemon juice | Bright pink / red | Acid |
| Vinegar | Pink | Acid |
| Baking soda solution | Blue / green | Base |
| Bleach (diluted) | Green / yellow | Base |
| Water | Purple (no change) | Neutral (pH 7) |

Teacher: "You can do this at home with a head of red cabbage, a pot, and some household liquids. It's safe, cheap, and fun. And now you can test anything — even your own saliva or soap."

Quick poll (show hands): "Raise your hand if you'd like to try the red cabbage test at home."

SEGMENT 6: Safety — What to Do If You Spill Acid or Base on Skin (4 minutes)

Teacher says: "Spills happen. Here's what to do depending on what you spill."

Show this table (read aloud and discuss):

| Type of Spill | First Action | Second Action | Do NOT Do |
|---|---|--|--|
| Acid spill (battery acid, vinegar, lemon juice) | Rinse with lots of cool water for 15+ minutes | Remove contaminated clothing while rinsing | Do NOT put baking soda or base on it first — water first |
| Base spill (bleach, drain cleaner, ammonia) | Rinse with lots of cool water for 15+ minutes | Remove contaminated clothing while rinsing | Do NOT put vinegar or acid on it first — water first |
| Unknown spill (don't know if acid or base) | Rinse with lots of cool water for 15+ minutes | Call Poison Control (1-800-222-1222) | Do NOT try to neutralize — just rinse |

Teacher explains: "The old advice was 'neutralize acid with baking soda' or 'neutralize base with vinegar.' That is wrong for skin. Neutralization creates heat — which can burn you more. The correct first step is always: rinse, rinse, rinse with water.

Water dilutes the chemical and washes it away. That's safer than trying to neutralize."

Partner talk (1 minute): "Tell your partner: You spill bleach on your arm. What is the first thing you do?"

Answer: Rinse with lots of cool water for at least 15 minutes. Call Poison Control if needed.

CLOSING — The 30-Second Challenge (3 minutes)

Teacher says: "Pair up. Person A: 30 seconds — explain what pH measures and give an example of a low pH (acid) and a high pH (base). Person B: 30 seconds — explain what happens when you mix bleach and vinegar, and what you should do if it happens by accident."

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

| You learned... | So you can... |
|--|--|
| Acid = gives hydrogen ions (sour taste) | Identify acidic household products (lemon, vinegar) |
| Base = takes hydrogen ions (slippery feel) | Identify basic household products (bleach, ammonia, baking soda) |
| pH scale (0-14) — low = acid, high = base, 7 = neutral | Predict whether a product is safe or dangerous |

| You learned... | So you can... |
|--|---|
| Bleach + vinegar = chlorine gas (deadly) | Never mix bleach with anything except water |
| Bleach + ammonia = chloramine gas (deadly) | Keep bleach away from ammonia cleaners |
| Red cabbage = natural pH indicator | Test household liquids at home for free |
| Acid/base on skin = rinse with water FIRST (15+ minutes) | Treat spills correctly — do NOT try to neutralize |

Final line (preview of next week): "Next week: Thermodynamics — why some reactions feel hot, some feel cold, and why a 'cold pack' you crack is safe for a sprained ankle. See you then."

SUPPLEMENTARY MATERIALS FOR LECTURE 7 (No Grade)

| Resource | Source | Description | Link / Search Term |
|---------------------------------------|---------------------------|--|--|
| Video: "Acids and Bases" | Khan Academy | 9-minute introduction | Search "Khan Academy acids and bases" |
| Red cabbage pH indicator instructions | Science Buddies / YouTube | Step-by-step video for making indicator at home | Search "red cabbage pH indicator" |
| PhET "pH Scale" simulation | University of Colorado | Interactive — test pH of household items virtually | Search "PhET pH scale" |
| Poison Control: Bleach and vinegar | poison.org | Official guidance on what to do | Search "poison control bleach vinegar" |
| Article: "The Chemistry of Antacids" | ACS ChemMatters | How bases neutralize stomach acid | Search "ChemMatters antacids" |

OPTIONAL "NO-PRESSURE" ASSIGNMENT

"Between now and next session, look at the ingredients on a cleaning product in your home. Does it say 'bleach' (sodium hypochlorite) anywhere? Does it say 'ammonia' or 'ammonium hydroxide'? If you see both, keep them stored far apart. Next time, tell us what you found."

DEFINITIONS SUMMARY FOR LECTURE 7 (Student Handout)

| Term | Simple Definition | Everyday Example |
|------|---|------------------------------------|
| Acid | A substance that gives away hydrogen ions (tastes sour) | Lemon juice, vinegar |
| Base | A substance that takes hydrogen ions (feels slippery) | Bleach, baking soda, ammonia |
| pH | A scale from 0 to 14 that measures how acidic or basic something is | pH 2 = lemon juice; pH 13 = bleach |

| Term | Simple Definition | Everyday Example |
|----------------|---|--|
| Neutral | pH 7 — not an acid or a base | Pure water |
| Neutralization | When an acid and a base mix and cancel each other out | Antacid (base) + stomach acid (acid) |
| pH indicator | A substance that changes color in acids vs. bases | Red cabbage juice, litmus paper |
| Chlorine gas | A deadly yellow-green gas created when bleach mixes with acid | Bleach + vinegar |
| Chloramine gas | A deadly gas created when bleach mixes with ammonia | Bleach + window cleaner (with ammonia) |