

CHEMDU · COMMUNITY CHEMISTRY · LEVEL 1

LECTURE 6

Solutions & Solubility

Like Dissolves Like: Why Water Won't Remove Grease — And Why That Could Save Your Skin

■ 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 dirty frying pan with grease

A bottle of dish soap

A poison label that says "oil-based"

Teacher says: "You spill coffee on your shirt. Water alone mostly works. You spill cooking oil on your shirt. Water alone does almost nothing. You have to use soap.

Now imagine you spill a poison on your skin — and the label says 'oil-based.' If you wash with only water, the poison stays on your skin. That's bad.

- Today's question: What makes something dissolve — and what makes it resist? *

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

Explain why water dissolves some things but not others

Tell someone how to safely remove an oil-based poison from skin

Read a product label to know whether water alone is enough"

SEGMENT 1: What Is a Solution? (6 minutes)

Teacher says: "Let's start with the most important word today: solution (suh-LOO-shun).

A solution is a mixture where one thing dissolves completely into another thing, like salt dissolving in water. You can't see the salt anymore — it's spread out evenly."

Show or draw this:

text

Salt (solid crystals) + Water (liquid) → Saltwater solution (clear,■■■■■)

Teacher continues: "A solution has two parts:

Solute (SAHL-yoot): The thing that gets dissolved. (Example: salt, sugar, lemonade powder)

Solvent (SAHL-vent): The liquid that does the dissolving. (Example: water, alcohol, paint thinner)

Everyday example: When you make lemonade, the powder is the solute and the water is the solvent. The powder disappears into the water. That's a solution."

Quick poll (show hands): "Raise your hand if you've ever made lemonade, iced tea, or hot chocolate from powder."

Teacher: "You made a solution. You already know chemistry."

Physical action: "Pretend your left hand is a solute (powder) and your right hand is a solvent (water). Now wiggle your fingers together — that's dissolving. Now your hands are one solution."

SEGMENT 2: The Magic Rule — "Like Dissolves Like" (10 minutes)

Teacher says: "Here is the most important rule in all of solution chemistry:

"Like dissolves like" (LYKE dis-SOLVZ LYKE)

That means:

Polar things dissolve in polar solvents (example: salt dissolves in water)

Non-polar things dissolve in non-polar solvents (example: oil dissolves in gasoline)

Definitions (new terms):

Term	Simple Definition	Everyday Example
Polar	A molecule with a slightly positive end and a slightly negative end	Water — oxygen end is negative, hydrogen ends are positive
Non-polar	A molecule with no positive or negative ends; evenly balanced	Oil, gasoline, wax, grease
Hydrophilic (high-dro-FILL-ik)	"Water-loving" — dissolves in water	Salt, sugar
Hydrophobic (high-dro-FOE-bik)	"Water-fearing" — does NOT dissolve in water	Oil, butter, wax

Show this table (draw or screen):

Solute (what dissolves)	Solvent (what does the dissolving)	Does it dissolve?	Why?
Salt (polar)	Water (polar)	■ YES	Like dissolves like
Sugar (polar)	Water (polar)	■ YES	Like dissolves like
Oil (non-polar)	Water (polar)	■ NO	Opposite — they repel
Oil (non-polar)	Gasoline (non-polar)	■ YES	Like dissolves like
Grease (non-polar)	Water (polar)	■ NO	Opposite — they repel
Grease (non-polar)	Dish soap (special — both polar AND non-polar)	■ YES	Soap is a bridge

Partner talk (2 minutes): "Tell your partner: Why doesn't oil dissolve in water? Use the words 'polar' and 'non-polar.'"

Teacher (after listening): "Oil is non-polar (no ends). Water is polar (has positive and negative ends). They repel each other — like pushing two magnets together the wrong way."

Physical action:

"Hold your hands flat, palms facing away (non-polar)."

"Now clasp your fingers together (polar)."

"Non-polar hands slide apart. Polar hands stick. That's like dissolves like."

SEGMENT 3: Why Soap Works — The Bridge (8 minutes)

Teacher says: "Soap is amazing because it has two personalities."

Draw or show this simple diagram:

text

Soap molecule:



Tail (non-polar) Head (polar)

(loves oil) (loves water)

Teacher explains:

The tail of the soap molecule is non-polar — it loves oil and grease.

The head of the soap molecule is polar — it loves water.

Soap acts like a bridge. One hand holds the oil. The other hand holds the water. The soap pulls the oil into the water so it can be rinsed away.

Everyday example: You fry eggs in a pan with oil. You try to rinse with just water — nothing happens. You add dish soap. The soap grabs the oil, and the water grabs the soap. The grease washes away."

Show this sequence (draw or screen):

Step	What Happens
1	Grease (non-polar) sits on the pan
2	Water (polar) alone — slides off, grease untouched
3	Soap added — tails grab grease, heads grab water
4	Rinse — soap + grease wash away together

Quick poll (show hands): "Raise your hand if you've ever washed a greasy pan with just water — and it didn't work."

Teacher: "Now you know why. Water and grease are opposites. Soap is the bridge."

SEGMENT 4: Safety Segment — Oil-Based Poisons (10 minutes)

Teacher says: "Here's where this knowledge could save a life or prevent a hospital visit."

Some poisons are water-based (polar). Some are oil-based (non-polar). How you wash them off depends on which they are."

Show this table (read aloud and discuss):

Type of Spill	Examples	Will Water Alone Remove It?	What to Use Instead
Water-based (polar)	Salt, sugar, some pesticides, some cleaning solutions	■ Yes — rinse with lots of water	Water (15+ minutes)
Oil-based (non-polar)	Gasoline, motor oil, oil-based paint, some pesticides, some poison ivy oils	■ No — water will spread it	Soap and water, or rubbing alcohol, or specialized cleaner

Teacher continues: "Here's the danger: If you spill gasoline (non-polar) on your hand and wash with only water, you are spreading the gasoline around. Some of it soaks into your skin. Some of it gets on other parts of your body. Water alone does NOT remove non-polar poisons."

What to do instead (three options):

Option	How It Works	Example
1. Soap and water	Soap bridges the gap — non-polar tail grabs oil, polar head grabs water	Dish soap for grease, hand soap for gasoline
2. Rubbing alcohol	Alcohol is polar AND non-polar — it dissolves many oil-based things	Removing poison ivy oil (urushiol)
3. Specialized cleaner	Made specifically for that poison	Read the label on the product

Partner talk (2 minutes): "Tell your partner: You spill motor oil on your arm. Should you rinse with water only? Why or why not? What should you use instead?"

Answer: "No — water alone won't remove oil. Use soap and water, or rubbing alcohol, then wash with soap."

Key safety rule (repeat together): "Water alone is not enough for oil. Add soap, or use alcohol."

SEGMENT 5: Concentration — How Much Is in There? (7 minutes)

Teacher says: "Another word you need to know: concentration (kon-sen-TRAY-shun)."

Concentration means how much solute is dissolved in a given amount of solvent.

Example: A little lemonade powder in a cup of water = low concentration (weak taste). A lot of powder in the same cup = high concentration (strong taste).

Everyday example you already know: Iced tea: one tea bag in a gallon = weak. Three tea bags = strong. That's concentration."

Show this table (concentration levels and what they mean for safety):

Product	Low Concentration	High Concentration	Danger of High Concentration
Bleach	Diluted 1:10 with water (safe for cleaning)	Full strength (undiluted)	Burns skin, lungs
Pool chlorine	1 cup per 10,000 gallons (safe)	3 cups per 10,000 gallons	Chemical burns
Medicine	Child dose (safe)	Adult dose for a child	Overdose possible
Pesticide	Diluted as label says (safe)	Double concentration	Poison risk

Teacher: "This is why you read labels. 'Concentrated' means you must dilute (add water or another solvent) before using. Dilution is the opposite of concentration — making something weaker by adding more solvent."

Quick check (show hands): "Raise your hand if you've ever seen a cleaning product label that says 'Concentrated — dilute before use.'"

Teacher: "That warning exists because if you don't dilute it, the concentration is too high — it could burn your skin or damage what you're cleaning."

SEGMENT 6: Saturation — When No More Will Dissolve (4 minutes)

Teacher says: "One last word: saturation (satch-uh-RAY-shun).

A solution is saturated when no more solute can dissolve. The solvent is full.

Everyday example: You stir sugar into cold iced tea. At first, the sugar dissolves. Keep adding sugar. Eventually, you see sugar crystals sitting at the bottom of the glass no matter how much you stir. That tea is saturated.

Why this matters for safety:

If you're mixing a cleaning solution, saturation means you've reached the limit — adding more powder won't make it stronger; it will just leave powder sitting at the bottom.

Some chemicals become dangerous if you try to force them to dissolve beyond saturation (heat can sometimes dissolve more — that's called supersaturated, and it can crystallize suddenly).

Teacher: "For everyday life, just remember: if powder is sitting at the bottom and won't dissolve, the liquid is full — stop adding more."

CLOSING — The 30-Second Challenge (4 minutes)

Teacher says: "Pair up. Person A: 30 seconds — explain why water alone won't remove oil from skin, and what you should use instead. Person B: 30 seconds — explain what 'like dissolves like' means, using the words polar and non-polar."

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

You learned...	So you can...
Solution = solute + solvent	Understand what dissolves and what does the dissolving
Like dissolves like — polar dissolves polar, non-polar dissolves non-polar	Predict whether water alone will remove a spill
Soap has a non-polar tail and a polar head — it's a bridge	Wash grease and oil off your skin and dishes
Water-based spills = rinse with water (15+ minutes)	Treat water-based poisons correctly
Oil-based spills = water alone is NOT enough — use soap, alcohol, or specialized cleaner	Remove gasoline, motor oil, poison ivy oil safely
Concentration = how much solute is in the solvent	Dilute concentrated products before use
Saturation = when no more solute can dissolve	Stop adding when powder sits at the bottom

Final line (preview of next week): "Next week: Acids & Bases. You'll learn why mixing bleach and vinegar creates deadly gas, how to test pH at home with red cabbage, and what to do if you spill battery acid on your skin. See you then."

SUPPLEMENTARY MATERIALS FOR LECTURE 6 (No Grade)

Resource	Source	Description	Link / Search Term
Video: "Like Dissolves Like"	Bozeman Science / YouTube	5-minute animation explaining polarity	Search "Bozeman Science like dissolves like"
PhET "Sugar and Salt Solutions" simulation	University of Colorado	Interactive — see sugar and salt dissolve at molecular level	Search "PhET sugar and salt solutions"
Poison control: Oil-based poison removal	poison.org	Official guidance on washing off non-polar chemicals	Search "poison control oil based skin decontamination"
Article: "Why Soap Works"	ACS ChemMatters	Free readable article on soap chemistry	Search "ChemMatters why soap works"

Resource	Source	Description	Link / Search Term
Hands-on activity (optional): Oil and water emulsion	Any science site	Shake oil, water, and dish soap in a bottle	Search "oil water soap emulsion experiment"

OPTIONAL "NO-PRESSURE" ASSIGNMENT

"Between now and next session, look at a cleaning product label in your home (dish soap, laundry detergent, all-purpose cleaner). Does it say 'concentrated' anywhere? Does it give dilution instructions (like 'mix 1 cap per gallon of water')? Next time, tell us what you found."

DEFINITIONS SUMMARY FOR LECTURE 6 (Student Handout)

Term	Simple Definition
Solution	A mixture where one thing dissolves completely into another (saltwater)
Solute	The thing that gets dissolved (salt, sugar, lemonade powder)
Solvent	The liquid that does the dissolving (water, alcohol, paint thinner)
Polar	A molecule with a slightly positive end and a slightly negative end (water)
Non-polar	A molecule with no positive or negative ends (oil, gasoline, wax)
Hydrophilic	"Water-loving" — dissolves in water (salt, sugar)
Hydrophobic	"Water-fearing" — does NOT dissolve in water (oil, grease)
Like dissolves like	Polar dissolves polar; non-polar dissolves non-polar
Concentration	How much solute is dissolved in a given amount of solvent (weak vs. strong)
Dilution	Adding solvent to make a solution less concentrated (adding water to juice)
Saturated	When no more solute can dissolve (sugar at the bottom of cold tea)