

Acids and Bases (All Grades)

In this demonstration students will be taught what makes acid and a base and how these two can be differentiated using an indicator. Students will then identify common acids and bases found in their homes. Students will also be shown how the reaction between acid and base leads to the erosion of an eggshell and the classic baking soda volcano experiment.

Grade-Specific Summary Table

This demo has three versions: Kindergarten, Grades 1-3, and Grades 4-6. This table covers all grades K-6.

Grade	Curriculum Focus	Demo Activity	Key Concept
Kindergarten	Matter - Object Properties	Cabbage juice indicator Lemon/soap color tests Acid vs base comparison	Objects have properties Similar/different properties Acids taste sour, bases taste bitter Indicators show acid/base
1	Matter - Measurable Properties Scientific Methods	pH scale introduction Cabbage juice indicator Litmus paper testing Worksheet activity	Objects have measurable properties (pH) Ask questions, make predictions Make observations using senses Safety during investigations
2	Scientific Methods - Investigations	Mystery acids/bases Cabbage indicator tests Litmus paper hands-on Worksheet scientific method	Develop questions for investigation Carry out procedures with purpose Gather and analyze data Collaborate and discuss findings
3	Scientific Methods - Data Analysis	All demonstrations Shell-less egg (acid-base reaction) Baking soda volcano Comparing acid/base reactions	Analyze data from investigations Make connections to prior knowledge Collaborate and discuss

			Notice changes and ask questions
4	Scientific Method - Evidence & Data Interpretation	Cabbage juice indicator Litmus paper testing Observation table Data recording	Evidence from investigation Interpretation of results Acids, bases, and pH scale Communicate findings
5	Controlled Variables & Cause/Effect	Baking soda volcano Variable changes (amount/concentration) Hypothesis testing Systematic procedure table	Designing experiments Controlling variables Cause-and-effect in chemical reactions Fair testing
6	Reliable Data & Human Impact	Acid rain discussion Ecosystem connections Shell-less egg experiment Advanced pH tests Environmental data analysis	Real-world impact Data supports explanation Acid rain effects Neutralization and environmental connection

Detailed Curriculum Links and Objectives by Grade

Kindergarten: Matter - Object Properties

Curriculum Link:

- Objects have identifiable properties.
- Objects may be similar in one or more properties and different in another property.

Objectives:

- Identify that objects have properties that can be observed (taste, sight, color).
- Learn acids taste sour (lemon) and bases taste bitter (soap) - no actual tasting.
- Understand indicators change color to show acid or base.
- Observe cabbage juice turns pink with acids (lemon juice), blue/green with bases (soap).
- Compare similarities: both liquids change cabbage juice color.
- Compare differences: different colors indicate different properties (acid vs base).
- Learn water is neutral - neither acid nor base, so cabbage juice stays purple.

Grade 1: Matter - Measurable Properties & Scientific Methods

Curriculum Link:

- Objects have measurable properties.
- Investigations involve asking questions, making predictions, and making observations using senses.
- Demonstrate safety and respect during investigations.

Objectives:

- Understand pH is a measurable property (scale 1-14) showing how acidic or basic something is.
- Learn pH 1-4 = very acidic (red/orange), pH 7 = neutral (purple/green), pH 12-14 = very basic (blue).
- Ask questions sparked by curiosity about acids and bases.
- Make predictions about whether liquids are acidic or basic.
- Make observations using sight (color changes with indicators).
- Use cabbage juice and litmus paper as indicators.
- Practice safety with gloves and careful handling of liquids.
- Complete worksheet documenting observations and conclusions.

Grade 2: Scientific Methods - Investigations

Curriculum Link:

- Develop questions for the purpose of an investigation.
- Investigations involve carrying out procedures for a purpose.
- Gather data and collaborate during investigations.

Objectives:

- Develop investigation question: "Is this substance an acid or base?"
- Write hypothesis predicting what will happen before testing.
- Follow step-by-step procedures: add indicator, observe color change, record results.
- Gather data by observing and recording color changes for multiple liquids.
- Test lemon juice (acid - pink/red), water (neutral - no change), detergent (base - blue).
- Collaborate with classmates by discussing observations and findings.
- Use litmus paper independently and report findings to class.
- Complete full scientific method worksheet with question, hypothesis, procedure, observations, and conclusion.

Grade 3: Scientific Methods - Data Analysis & Chemical Reactions

Curriculum Link:

- Investigations build on previous knowledge by supporting or contradicting existing knowledge.
- Data can be analyzed by making connections to previous knowledge, collaborating, comparing for accuracy, asking questions, and noticing changes.
- Analyze data collected during investigations.

Objectives:

- Analyze patterns in data: acids consistently turn indicators red/pink, bases turn indicators blue.
- Make connections to previous knowledge: recall acids are sour, bases are bitter.
- Collaborate by discussing why certain liquids behave as acids or bases.
- Compare observations for accuracy across different tests and indicators.
- Notice changes during chemical reactions: bubbling (CO₂ gas), temperature changes, color shifts.
- Understand shell-less egg: vinegar (acid) reacts with calcium carbonate (base) in shell, dissolving it over time.
- Understand baking soda volcano: vinegar (acetic acid) + baking soda (sodium bicarbonate) → neutralization reaction producing CO₂ gas (bubbles/foam).
- Learn reaction equation: acid + base → salt + water + carbon dioxide.
- Recognize stronger bases (baking soda vs soap) create more aggressive reactions with

acids.

- Apply learning: citric acid in lemon juice can also react with baking soda, similar to vinegar.

Grade 4: Scientific Method - Evidence & Data Interpretation

Curriculum Link:

- Scientific method: Ongoing collection of evidence expands and refines knowledge.
- Interpret and communicate results from investigation.

Objectives:

- Recognize acids and bases with indicators.
- Learn pH values (0–14) and indicators show acidic (red), neutral (green), basic (blue).
- Gather evidence systematically, record all results accurately, and interpret outcomes using conclusion tables.
- Communicate findings clearly and discuss how investigation supported or changed initial ideas.
- Understand that repeated testing and data collection strengthens scientific conclusions.

Grade 5: Controlled Variables & Cause/Effect in Experiments

Curriculum Link:

- Experiments require carefully controlled variables to establish cause and effect.
- Design and conduct controlled investigations.

Objectives:

- Understand variables in experiments (amount, concentration, temperature).
- Predict and test how changing one variable affects the result while keeping others constant.
- Conduct fair tests by changing only one variable at a time, record data systematically, compare outcomes.
- Use complete scientific method: question, hypothesis, procedure, results, conclusion.
- Recognize that changing amount of vinegar or baking soda changes reaction intensity (more bubbles, faster reaction).
- Design own investigations by choosing which variable to test.

Grade 6: Reliable Data, Human Impact & Environmental Connections

Curriculum Link:

- Explanations supported by reliable data and references.
- Understand that human activities (acid rain) can affect Earth systems.

Objectives:

- Explain neutralization reactions and connect to environmental issues.
- Explore impacts of acid rain: erosion of limestone buildings/statues, harm to aquatic ecosystems, forest damage.
- Relate acid–base chemistry to real-world events and human impact.
- Evaluate data reliability and use multiple sources to support conclusions.
- Link laboratory experiments to outside world: shell-less egg models acid rain effect on limestone.
- Understand acid rain forms when sulfur dioxide and nitrogen oxides react with water in atmosphere.
- Discuss solutions: reducing emissions, using cleaner energy sources.

Scientific Method Integration (All Grades)

All acid and base demonstrations incorporate scientific method steps appropriate to each grade level:

- Kindergarten: Basic observation and comparison
- Grade 1: Questions, predictions, observations, safety
- Grade 2: Full investigation cycle with hypothesis and data collection
- Grade 3: Data analysis, connections to prior knowledge, understanding chemical reactions
- Grade 4: Evidence collection, data interpretation, communicating findings
- Grade 5: Designing controlled experiments, testing variables, cause-and-effect
- Grade 6: Using reliable data, environmental connections, real-world applications

Activity-Based Summary Table

Demo Activity	Curriculum Outcome	Key Concepts
Cabbage Juice Indicator Introduction	Object properties, Observation using senses, pH scale	Cabbage juice changes color: pink = acid, purple = neutral, blue/green = base
Mystery Acids and Bases	Making predictions, Investigations	Identify unknown liquids as acid/base using indicator color changes
pH Scale Introduction	Measurable properties	pH 1-4 (acidic/red), pH 7 (neutral/purple), pH 12-14 (basic/blue)
Litmus Paper Testing	Hands-on investigation, Data collection	Red litmus = acid, Blue litmus = base, No change = neutral (water)
Lemon Juice, Water, Detergent Test	Scientific method, Comparing substances	Lemon = acid (pink), Water = neutral (purple), Detergent = base (blue)
Shell-less Egg Experiment	Chemical reactions, Data analysis over time, Environmental modeling	Vinegar (acid) dissolves calcium carbonate (base) shell over 1 week; models acid rain erosion
Baking Soda & Vinegar Volcano	Acid-base reactions, Observing changes, Controlled variables	Neutralization reaction produces CO ₂ gas (bubbling/foaming); test variables (amounts/concentrations)
Acid Rain Simulation & Discussion	Human impact, Environmental connections, Reliable data	Acid rain process, ecosystem consequences, real-world applications