

Acids (and Bases) Evaluation Information Page

Search Terms:

- bronsted lowry acids and bases
- strong vs weak acids
- Acid and Base Conceptually
- What is an acid?
- strong acids and bases
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- What are acids and bases?
- Acid and Base Chemistry
- What makes an acid an acid
- acid and base reactions

Broad definition of what we are considering

We are considering primarily the conceptual understanding of why compounds act as an acid or a base. We are considering both Bronstead-Lowry and Lewis Acids and Bases.

We will not code videos that just identify or predict the products of acid-base reactions in equations or identify conjugate acids and bases in a chemical equation.

*We will not code videos that provide a definition of an acid (e.g., a proton donor) (and/or base) and then give examples of acids or bases using that definition to identify an acid. **We will code the video if it provides the definition and uses that definition to identify examples IF it also includes something additional, e.g., looks at structural features of the example compounds that correspond to acid behaviour.***

Johnstone's Triangle Elements

Element	Examples
Macroscopic	Showing that a solution is acidic or basic using a pH meter or pH paper. Examples of common things (lemon juice, vinegar, baking soda) that are acids or bases including talking about taste. Examples of acids and bases reacting (e.g., vinegar and baking soda). Pouring an acid into water.
Symbolic	Chemical equations showing acids as proton donors and bases as proton acceptors. Lewis structures of single acid molecules showing acidic H, resonance stabilization of conjugate base, arrows showing inductive effect. Ka expression equations. An electron pushing mechanism is symbolic not particulate.
Particulate	Particle diagrams illustrating what happens when acids or bases dissolve in water, what happens when they react. Just having a particle drawing in an equation does not count. Must somehow show HOW the particles interact for acids/bases dissolving in water or reacting. Bohr model to show relative size of ions related to stability. NOT just larger or smaller circles unless they talk about size of electron cloud/number of electrons related to size of the circle.
Connection between levels	Videos should make explicit connections between two or more levels for this to be coded as present. For example, they could show the chemical reaction along with a particle level drawing or animation.

Core Ideas

Core Idea Elements		
Change and Stability in Chemical Systems	Atomic/Molecular Structure & Properties	Electrostatic Bonding and Interactions
Energy and entropy changes, the rates of competing processes, and the balance between opposing forces govern the fate of chemical systems. Video needs to include: Discussion of why acids dissociate in water (reacting with water and donating a proton) or why it reacts with a base. Must explicitly mention stability. This may focus on the relative stability of the conjugate base of an acid, without in-depth discussion about the structural features which lead to that stability.	The macroscopic physical and chemical properties of a substance are determined by the three-dimensional structure, the distribution of electron density, and the nature and extent of noncovalent interactions between the particles. Video needs to include: Discussion of how the structural features of a molecule impacts its relative strength as an acid or base (will usually need to compare multiple acids or bases) e.g. a more stable conjugate base will be linked to a stronger acid	Attractive and repulsive electrostatic forces govern noncovalent and bonding (covalent and ionic) interactions between atoms and molecules. The strength of these forces depends on the magnitude of the charges involved and the distances between them. Video needs to include: Discussion of acid base reactions in terms of electrostatics/polarity (e.g., positive/slightly positive end of one species reacts negative/slightly negative end of another species)

Scientific Practices

Scientific Practices Criteria (must satisfy all criteria)
SP 1: Asking Questions ☐ Instruction presents an event, observation, phenomenon, data, scenario, or model. ☐ Instruction has instructor/students <i>generate</i> an empirically testable question about the given event, observation, phenomenon, data, scenario, or model. (Question cannot be rhetorical or simply a part of instruction; rather it must be a <i>process of generating</i> a testable question.)
SP 2: Developing and Using Models ☐ Instruction presents an event, observation, or phenomenon for instructor/students to explain or make a prediction about. ☐ Instruction presents a representation or asks instructor/students to construct a representation. ☐ Instruction has instructor/students explain or make a prediction about the event, observation, or phenomenon. ☐ Instruction has instructor/students provide the reasoning that links the representation to their explanation or prediction.
SP 3: Planning Investigations ☐ Instruction poses a scientific question, claim, or hypothesis to be investigated.

- ☐ Instruction has instructor/students describe or design an investigation, or identify the observations required to answer the question or test the claim or hypothesis.
- ☐ Instruction has instructor/students justify how their description, design, or observations can be used to answer the question or test the claim or hypothesis.

SP 4: Analyzing and Interpreting Data

- ☐ Instruction presents a scientific question, claim, or hypothesis to be investigated.
- ☐ Instruction provides a representation of data (table, graph, or list of observations) used to answer the question or test the claim or hypothesis.
- ☐ Instruction provides an analysis of the data or asks instructor/students to analyze the data.
- ☐ Instruction has instructor/students interpret the results or assess the validity of the conclusions in the context of the scientific question, claim, or hypothesis.

SP 5: Using Mathematics and Computational Thinking

- ☐ Instruction presents an event, observation, or phenomenon.
Instruction has instructor/students perform a calculation or statistical test, generate a mathematical representation, or demonstrate a relationship between parameters.
- ☐ Instruction has instructor/students give a consequence or an interpretation in words, diagrams, symbols, or graphs of their mathematical results while demonstrating reasoning in the context of the given event, observation, or phenomenon.

SP 6: Constructing Explanations and Engaging in Argument from Evidence

- ☐ Instruction presents an event, observation, or phenomenon.
- ☐ Instruction presents or asks instructor/students to make a claim based on the given event, observation, or phenomenon.
- ☐ Instruction has instructor/students provide scientific principles or evidence (data or observations) to support the claim.
- ☐ Instruction has instructor/students provide reasoning about why the scientific principles or evidence support the claim.

SP 7: Evaluating Information

- ☐ Instruction provides an excerpt from a conversation, article, student solution, or other communication that makes one or more assertions.
- ☐ Instruction presents a conclusion about the validity of the assertion(s) made or asks instructor/students to make a conclusion about the validity of the assertion(s), or reconcile multiple assertions with each other.
- ☐ Instruction has instructor/students provide reasoning to support their conclusion(s) about the validity of the assertion(s) or reconciliation with data, observations, or scientific principles.

Causal Mechanistic Reasoning - Must have Both How and Why!

Option 1: What causes acids to react?

How: Acids react, generally by donating H^+ ions, to form products that are more stable. OR The more stable the anion formed when an acid dissociates in water, the greater the amount of dissociation and stronger the acid. ***Must mention stability***

Why: Acidic H atoms are generally bonded to highly electronegative atoms (O or halogens). In donating the acidic H ion to another species more stable products are formed, generally a stable anion and in the case of acid dissolving in water, H_3O^+ . The more stable the products, the more product favored the equilibrium system will be. ***Does not need to explicitly address equilibrium.***

Option 2: What makes a substance more or less acidic? (Assuming we will see this for Bronstead-Lowry acids)

How: Molecules with polar H-X bonds and that form stable conjugate base (anions) when dissociated are stronger acids.

Why: Anions that can delocalize the negative charge by having the negative charge on larger electronegative atoms (e.g., Cl^-) or on anions that are stabilized by inductive effects or resonance are more stable. ***(Note: A more stable conjugate base will make the process of losing an H^+ less energetically unfavorable - videos are not required to have this piece, but please note if the video does explicitly include the energy piece.)***

Multimedia Principles

Multimedia learning as knowledge construction: The goal of multimedia presentations is not only to present information but also to provide guidance for how to process the presented information – that is, for determining what to pay attention to, how to mentally organize it, and how to relate it to prior knowledge. We will categorize the videos along each of the following criteria (High and Low should be mutually exclusive.)

High	Low
• Video almost exclusively involves <u>meaningful and relevant</u> images and verbal components <u>AND images are explained for a novice learner</u> • Text on screen is minimal (ex. Only brief bullet points or keywords if text is used) • Content is all relevant to the topic and learning (no music, unhelpful animations, graphics, etc.) • Contains elements that meaningfully support student organizing content or identify key ideas (introductory organizer, section heading, summary, guiding questions/topic (for short, focused video only) Key Question: Could a novice learner clearly understand what they should take away from the video? Yes=high.	• Large segments of video are presented just verbally and not pictorially (ex. just the instructor talking, or just written words) OR images presented are not relevant to learning or explained • Contains full sentences of written text that are also narrated (<i>e.g., several bullet points or sentences on one screen OR full sentences of text on many screens includes forced closed captioning</i>) • Contains extraneous content, music, graphics, animations, background changes, sounds, or just too much stuff on the screen at one time - anything that detracts attention from core content • Does not contain any elements that meaningfully help learners organize content or identify key ideas (e.g., no introductory organizer, section headings, video segments, summary, guiding question/topic (for short focused videos only)

Misleading vs. Inaccuracies

- Several minor spelling issues is misleading, not inaccurate