

# ChemSims: Anything but basic- using screencasts to support student understanding of acids

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## Background Literature

- Common issues:
  - Conflation of acid strength and concentration<sup>1</sup>
  - pH measures acid strength not  $\text{H}_3\text{O}^+$  concentration<sup>2</sup>
- Shorter learning modules increase retention<sup>3</sup>

## ChemSims Findings

- Enhanced screencasts can explicitly address conceptual challenges<sup>4</sup>
- Screencasts help lower cognitive demand<sup>5</sup> and focus attention on key areas<sup>6</sup>

Figure 1: Previous edition of screencast

Acid Strength		pH		Acid Concentration	
Strong v. Weak Acids	Questions	Exploring pH	Questions		

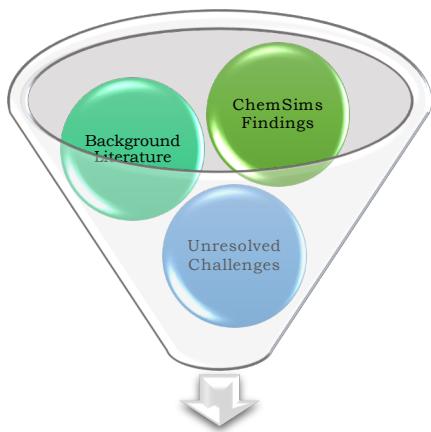
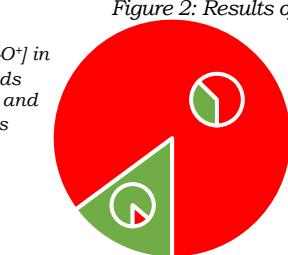
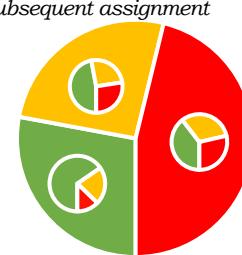


Figure 2: Results of pretest and subsequent assignment



\*large circles indicate pretest scoring, small circles indicate posttest scoring



- Correct

*"pH is a measure of  $[\text{H}_3\text{O}^+]$  in solution, and strong acids have the highest  $[\text{H}_3\text{O}^+]$  and  $[\text{A}^-]$  therefore beaker C is going to have the lowest pH."*
- Incorrect

*"Because it is the most concentrated and strongest acid so therefore it would have the lowest pH."*

- Incorrect

*"Because it is the most concentrated and strongest acid so therefore it would have the lowest pH."*

*"Explain why a solution would have the lowest pH; include what pH is a measure of..."*

## Data analysis

## Unresolved Challenges

## Revisions

Struggle to recognize strong acids have no HA remaining after dissociation

Distinguishing between acid strength and concentration

Relating strength to pH and not to dissociation

Explicitly defined acid strength

Explicitly connected  $K_a$  to acid strength

- PhET simulation walkthrough
- Targeted questions
- New supplemental content
- Students' independent use of the simulation

Acid Strength			pH			Acid Concentration		
Dissociation of Acids in Water	Strong v. Weak Acids	Equilibrium Arrows	Relative Acid Strength	$K$ and $K_a$	Defining pH: Logarithmic scale and Inverse Relationship	Questions	Questions	Questions

## References

1. Jasien, P. G. (2011). What Do You Mean That "Strong" Doesn't Mean "Powerful"?  
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4. Méndez-Carbajal D.; Wolla S.A. Am J Distance Educ. 2019, 33(2), 108-119
5. Jessica R. VandenPlas, Deborah G. Herrington, Alex D. Shrode, and Ryan D. Sweeder, Use of Simulations and Screencasts to Increase Student Understanding of Energy Concepts in Bonding, *Journal of Chemical Education* (2021)
6. Ryan D. Sweeder, Deborah G. Herrington, Jessica R. VandenPlas "Students' Independent Use of Screencasts and Simulations to Construct Understanding of Kinetics", *Chem. Ed. Res. Pract.* (2019)
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