

Chem 108: Class/ Lab

Week 13

Pick a vial and a plastic dropper

Using the vial number, sign-in on the Lab roster

Pick up HANDOUTS

- 1) Fluid Exchange Form & Post Lab
(Handout)
- 2) Acid-Bases: pH
(Handout)

Chem 108: Class/ Lab

Week 13: 2019f

Do Today:

1) Fluid Exchange (Handout)

Due Next Lab

2) Acid-Base: pH (Handout)

Data completed & signed before leaving Lab

Follow Instructions

<http://chemconnections.org/general/chem120/fluid-ex.108.html>

Chem 108: Class/ Lab

Week 13

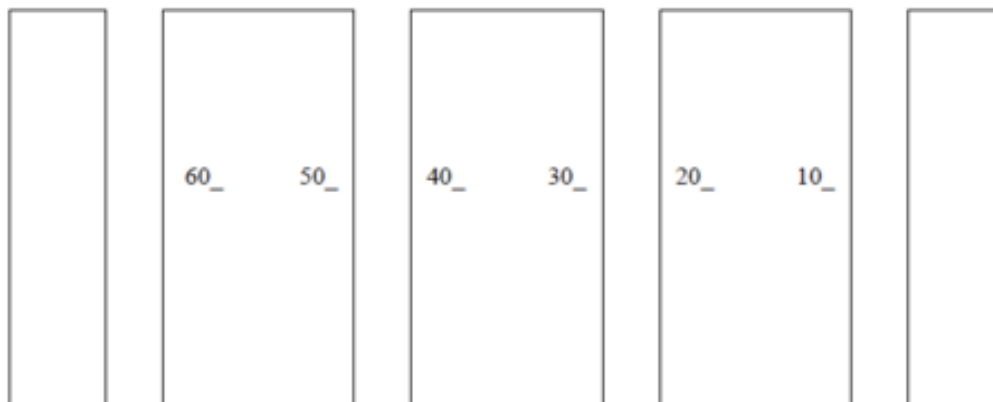
TODAY:

Fluid Exchange (Handout)

3) You have been assigned a geographical location for your Global Residence. Check the *Global Homelands Map*, which follows, for your location and if necessary move to your place of residence.

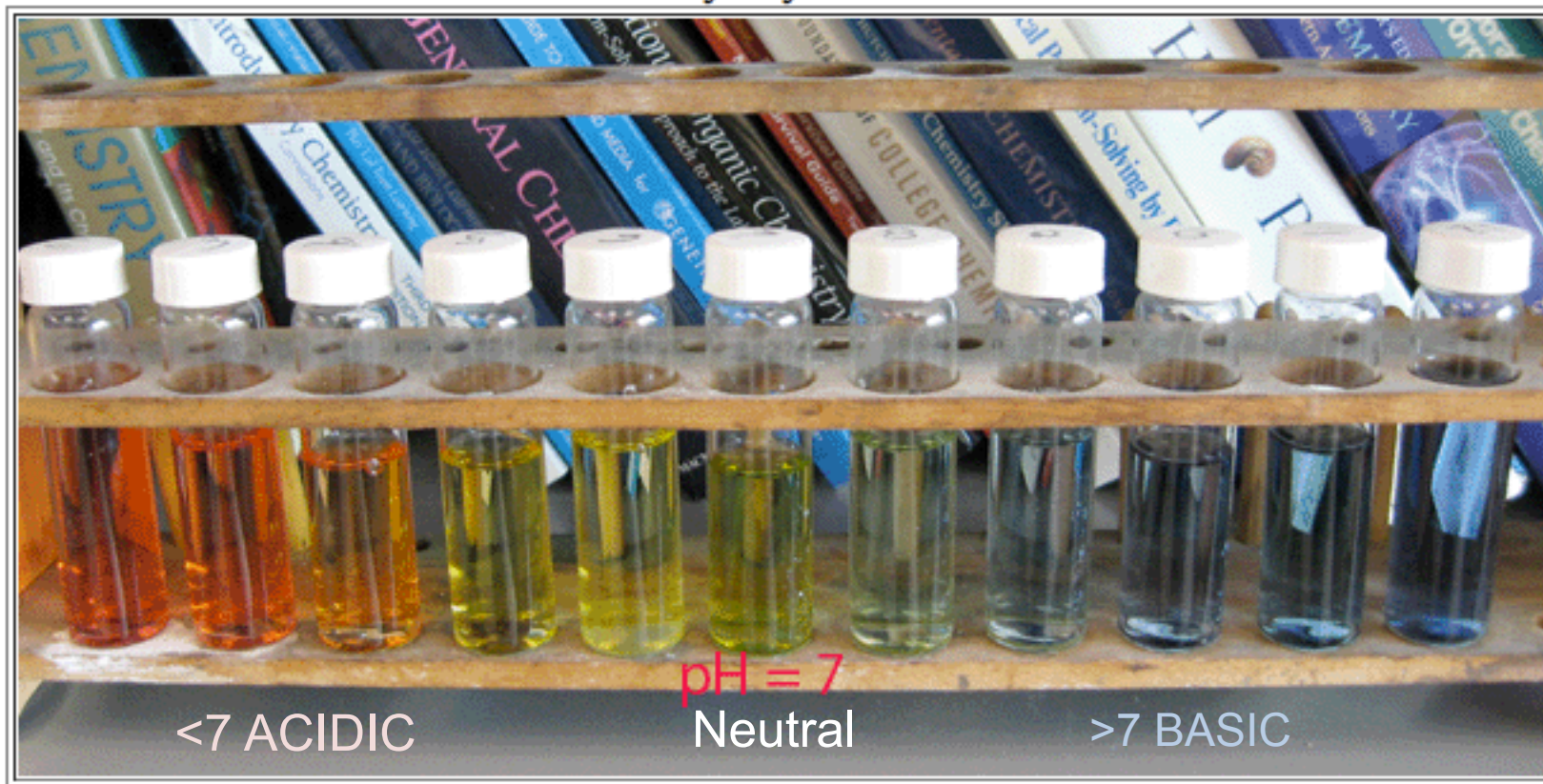
<http://chemconnections.org/general/chem120/fluid-ex.108.html>

Global Homelands Map
(Front of Lab)



Wait for Dr. R's instructions on exchanging fluids, keeping records, and using the handout provided.

Acid-Base Indicators

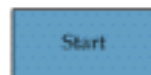
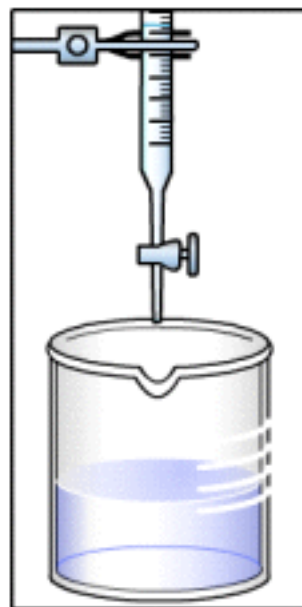


Water as an Acid and a Base

Self-ionization



Click on Start button to begin.

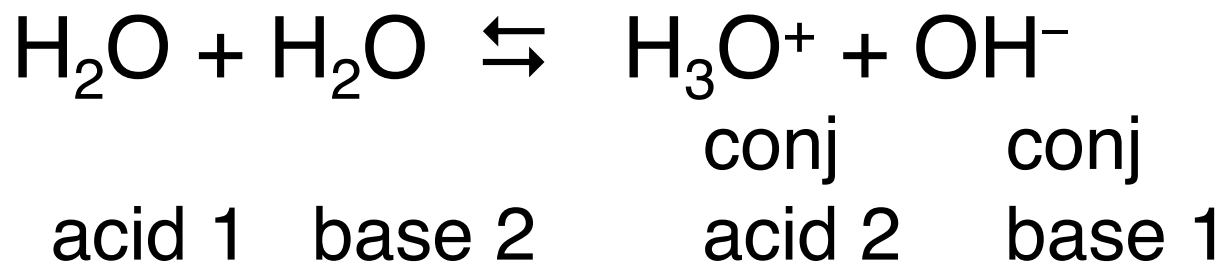


[H ₃ O ⁺]	[OH ⁻]

<http://chemconnections.org/general/movies/KwActivity.swf>

Pure Water is an Acid and a Base

It is **amphoteric**. (It can behave either as an acid or a base).



$$K = \frac{[\text{H}_3\text{O}^+][\text{OH}^-]}{[\cancel{\text{H}_2\text{O}}][\cancel{\text{H}_2\text{O}}]} \quad \bullet \quad K_w = 1 \times 10^{-14} \text{ at } 25^\circ\text{C}$$

$$\bullet \quad K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = [1 \times 10^{-7}\text{M}][1 \times 10^{-7}\text{M}]$$

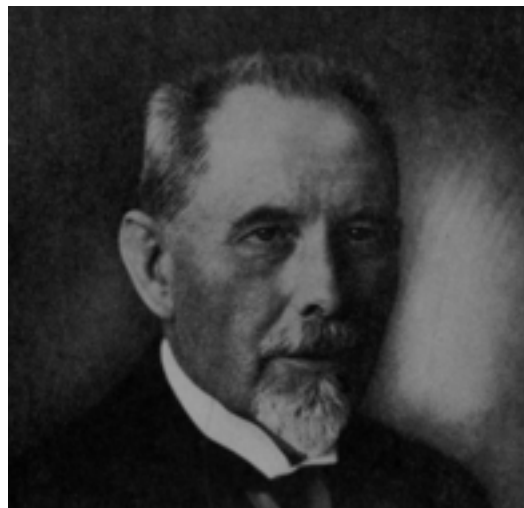
NOTE: only concentrations [mol/L] are used in the calculation;
liquids (l) and solids (s) are not included

The pH Scale

pH: the negative logarithm of the hydrogen ion concentration.

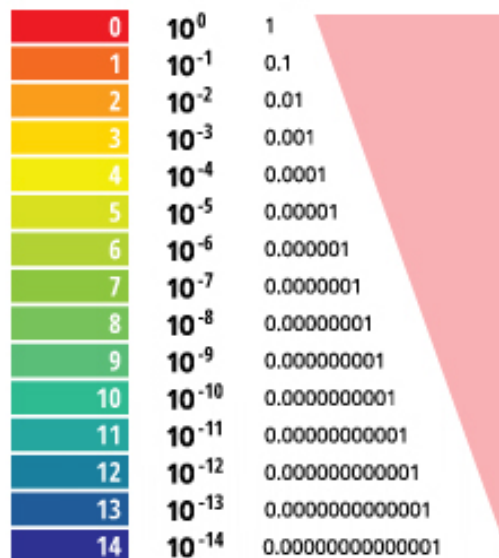


Beer's pH ~ 4



Quantitative, logarithmic, numeric scale based on testing the electric current of aqueous solutions & relating it to the equilibrium concentration of the hydrogen ion,
 $[H^+_{(aq)}] = [H_3O^+_{(aq)}]$

$$pH = -\log[H^+]$$



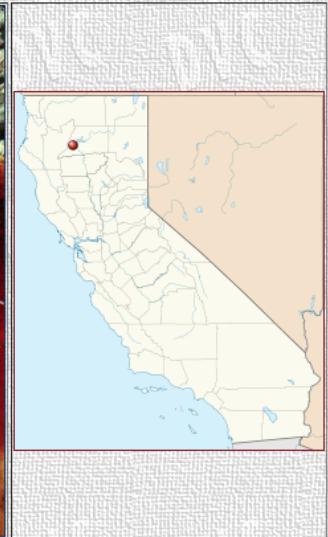
Introduced in 1909 by Søren Sørensen, Danish brewer/chemist, as a convenient way of expressing acidity..... Providing much improved quality control in brewing.

The pH Scale

- $\text{pH} \approx -\log[\text{H}^+] \approx -\log[\text{H}_3\text{O}^+]$
- pH in water ranges from 0 to 14.
 $K_w = 1.00 \times 10^{-14} = [\text{H}^+][\text{OH}^-]$
 $\text{p}K_w = 14.00 = \text{pH} + \text{pOH}$
- As pH rises, pOH falls (sum = 14.00).
- There are no theoretical limits on the values of pH or pOH. (e.g. pH of 2.0 M HCl is -0.301)

The pH Scale

Abandoned Mine Lands Case Study



Iron Mountain Mine

Success Through Planning, Partnerships, and Perseverance









The drainage water from the Iron Mountain Mine is the most acidic water on Earth; some samples collected in 1990 and 1991 have been measured to have a pH value of -3.6, which is the lowest pH observed globally in a natural environment.

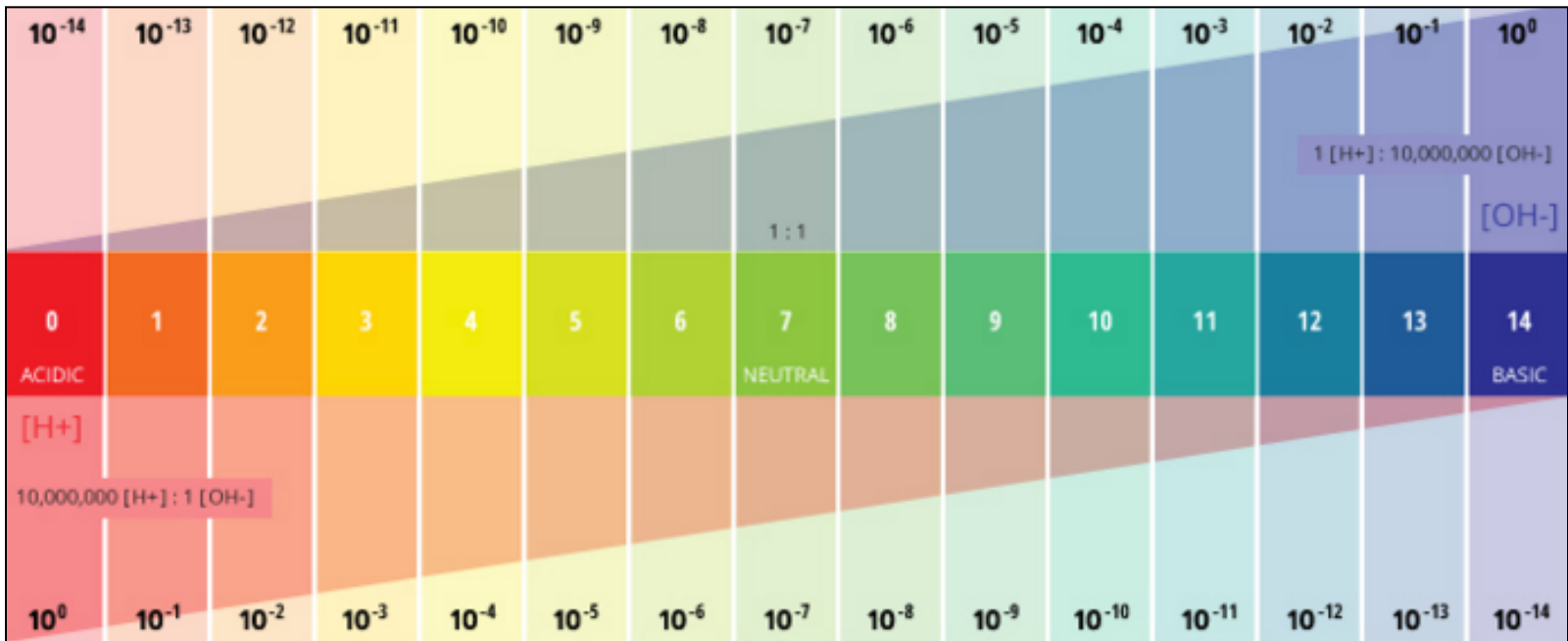
Indicators

Natural Indicators

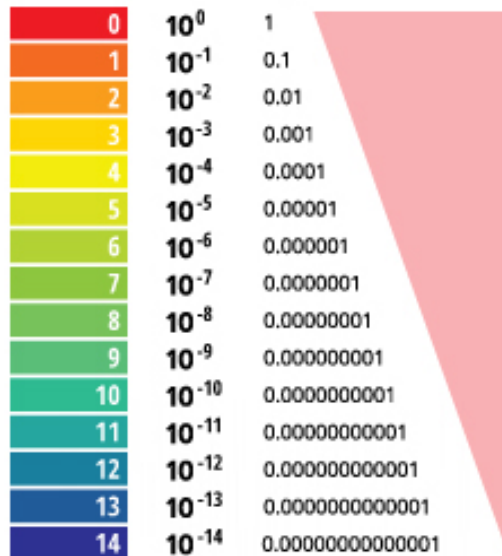


Acid-Base Indicators

	pH range for color change													
	0	2	4	6	8	10	12	14						
Methyl violet	Yellow		Violet											
Thymol blue	Red		Yellow		Yellow		Blue							
Methyl orange			Red		Yellow									
Methyl red				Red		Yellow								
Bromthymol blue					Yellow		Blue							
Phenolphthalein						Colorless		Pink						
Alizarin yellow R							Yellow		Red					



$$pH = -\log[H^+] = -\log[H_3O^+]$$



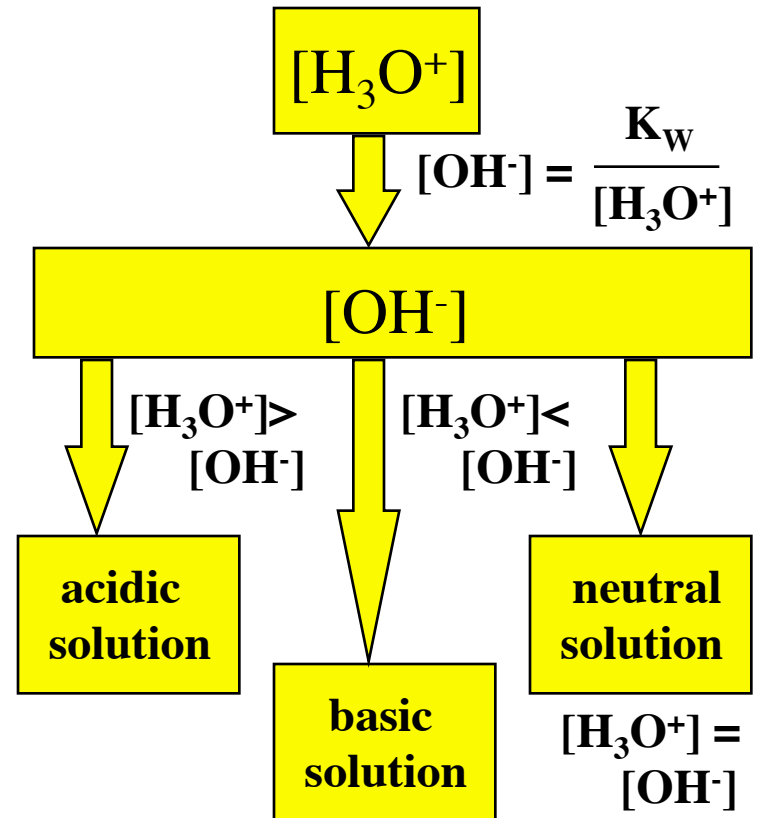
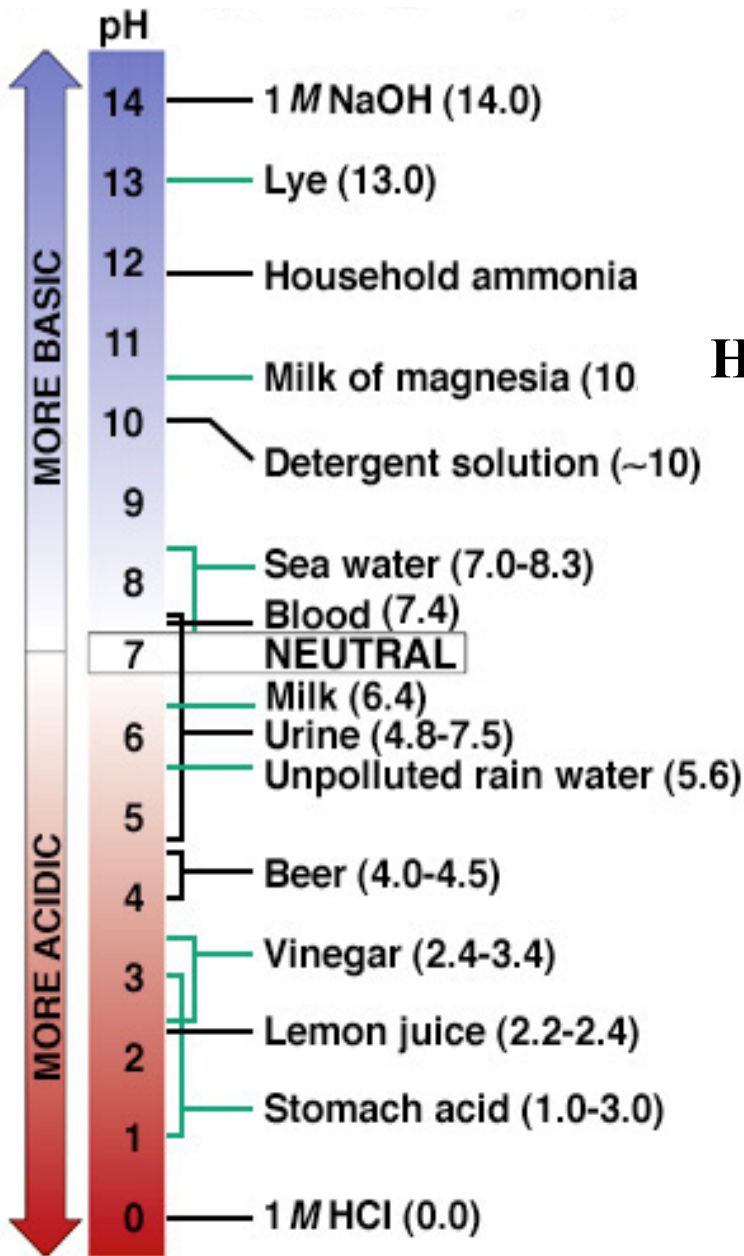
The Relations Among $[H_3O^+]$, pH, $[OH^-]$, and pOH



	$[H_3O^+]$	pH	$[OH^-]$	pOH
BASIC	1.0×10^{-15}	15.00	1.0×10^1	-1.00
	1.0×10^{-14}	14.00	1.0×10^0	0.00
	1.0×10^{-13}	13.00	1.0×10^{-1}	1.00
	1.0×10^{-12}	12.00	1.0×10^{-2}	2.00
	1.0×10^{-11}	11.00	1.0×10^{-3}	3.00
	1.0×10^{-10}	10.00	1.0×10^{-4}	4.00
	1.0×10^{-9}	9.00	1.0×10^{-5}	5.00
	1.0×10^{-8}	8.00	1.0×10^{-6}	6.00
NEUTRAL	1.0×10^{-7}	7.00	1.0×10^{-7}	7.00
ACIDIC	1.0×10^{-6}	6.00	1.0×10^{-8}	8.00
	1.0×10^{-5}	5.00	1.0×10^{-9}	9.00
	1.0×10^{-4}	4.00	1.0×10^{-10}	10.00
	1.0×10^{-3}	3.00	1.0×10^{-11}	11.00
	1.0×10^{-2}	2.00	1.0×10^{-12}	12.00
	1.0×10^{-1}	1.00	1.0×10^{-13}	13.00
	1.0×10^0	0.00	1.0×10^{-14}	14.00
	1.0×10^1	-1.00	1.0×10^{-15}	15.00

The pH Values of Some Familiar Aqueous Solutions

(TODAY'S LAB EXPERIMENT)



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1) Fluid Exchange
(Handout) *Due Next Lab*

TODAY:

2) Acid-Base: pH (Handout)

Data table completed & signed before leaving Lab

Due Next Week:

Fully Completed Handout plus On-line Questions

<http://chemconnections.org/general/chem108/Acids-Bases%20Guide.html>

Acid-Base Strengths

pH [indicator paper & pH meter]

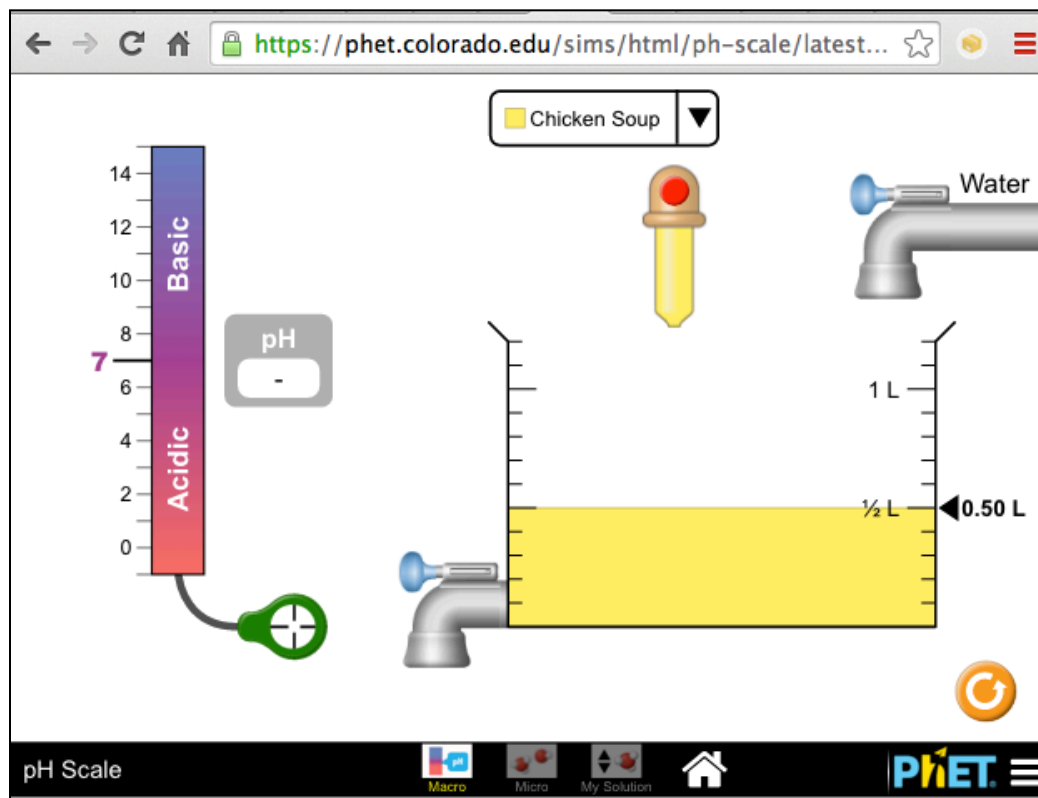
<https://phet.colorado.edu/en/simulation/ph-scale>

Strong Acid:

Strong Base:

Weak Acid:

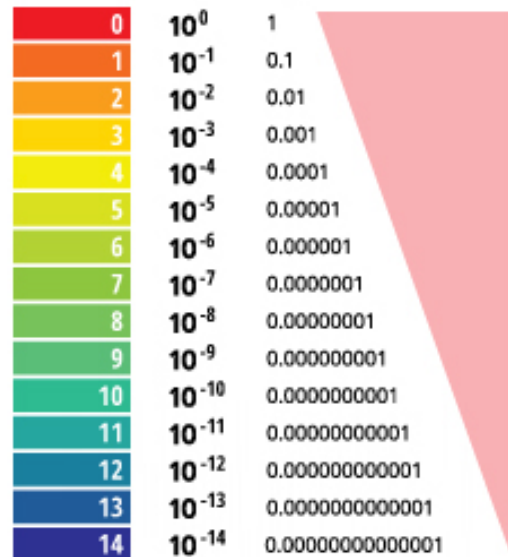
Weak Base:



<http://www.chemconnections.org/general/chem108/Acids-Bases%20Guide.html>



$$\text{pH} = -\log[\text{H}^+]$$



		Red Litmus	Blue Litmus	Solution pH		pH Meter	Description
				pH Paper	Indicator		
A	HCl(aq) [stomach acid]	red	red	1	2	1.0	acid
B	NaOH(aq) [drain cleaner]	blue	blue	13	14	13.0	base
C	H ₂ O(l) [deionized water]	red	blue	7	7	7.0	Neutral (H ₂ O is BOTH: acid & base)
D	H ₂ O(l) + CO ₂ (aq) [carbonated water] (Seltzer)						
E	Na ₂ CO ₃ (aq) [sodium carbonate]						
F	CH ₃ COOH(aq) [acetic acid] (vinegar)						
G	CH ₃ COO ⁻ , Na ⁺ (aq) [sodium acetate]						

H	NH ₃ (aq) [ammonia] (cleaner)						
I	NH ₄ Cl(aq) [ammonium chloride]						
J	NaCl(aq) [sodium chloride]						
K	NaOCl(aq) [sodium hypochlorite] (bleach)						
L	Mg(OH) ₂ Milk of Magnesia						
M	Lemon juice						
N	Milk	red	red	6	7		
O	Saliva (spit) and blood	blue	blue	7	7		
P	Vomit	red	red	1	2		
Q	Buffer (pH 7)	red	blue	7	7		

Adapted from Workshop Chemistry

Chem 108 / Dr. Rusoy

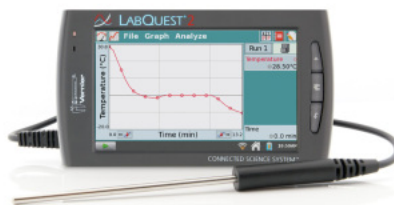
Names: _____

Acids - Bases: pH Lab & Worksheet

Simulations: https://phet.colorado.edu/sims/html/pH-scale/latest/pH-scale_en.html
 On-line questions & submission form: <http://chemconnections.org/general/chem108/Acids-Bases%20Guide.html>

Lab pH: pH Meter

		Red Litmus	Blue Litmus	Solution pH		pH Meter	Description
				pH Paper	Indicator		
A	HCl(aq) [stomach acid]	red	red	1	2	1.0	acid
B	NaOH(aq) [drain cleaner]	blue	blue	13	14	13.0	base
C	H ₂ O(l) [deionized water]	red	blue	7	7	7.0	Neutral (H ₂ O is BOTH: acid & base)
D	H ₂ O(l) + CO ₂ (aq) [carbonated water] (Seltzer)					6.4	
E	Na ₂ CO ₃ (aq) [sodium carbonate]					10.1	
F	CH ₃ COOH(aq) [acetic acid] (vinegar)					4.7	
G	CH ₃ COO ⁻ , Na ⁺ (aq) [sodium acetate]					8.4	
H	NH ₃ (aq) [ammonia] (cleaner)					12.0	
I	NH ₄ Cl(aq) [ammonium chloride]					6.1	
J	NaCl(aq) [sodium chloride]					7.0	
K	NaOCl(aq) [sodium hypochlorite] (bleach)					10.9	
L	Mg(OH) ₂ Milk of Magnesia					12.2	
M	Lemon juice					3.8	
N	Milk	red	red	6	7	6.4	
O	Saliva (spit) and blood	blue	blue	7	7	7.3	
P	Vomit	red	red	1	2	1.9	
Q	Buffer (pH 7)	red	blue	7	7	7.0	



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1) Fluid Exchange
(Handout) *Due Next Lab*

TODAY:

2) Acid-Base: pH (Handout)

Show Dr. R your well plate with test solutions and indicator, and your completed data table, which corresponds to the wells; to be signed before leaving Lab

Due Next Week:

Fully Completed Handout plus On-line Questions

<http://chemconnections.org/general/chem108/Acids-Bases%20Guide.html>

