a, b, c, d; e-g

Proton Shuffle

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ChemCatalyst:

- Q: Do you think bicarbonate is an acidic, basic or neutral substance?

- Besides HCl, the digestive system also produces a compound called bicarbonate HCO_3^-. Bicarbonate plays a vital role in regulating the pH of the digestive system.

Notes:

- Is there more to Arrhenius' definition of acids & bases?

- Arrhenius definitions of acids & bases
  - acid: adds H^+ to the solution
  - base: adds OH^- to the solution
  - works for obvious substances like...

$$HCl \rightleftharpoons H^+ + Cl^-$$
$$H_2SO_4 \rightleftharpoons H^+ + HSO_4^-$$
$$HNO_3 \rightleftharpoons H^+ + NO_3^-$$

} all acids

$$NaOH \rightleftharpoons Na^+ + OH^-$$
$$NH_4OH \rightleftharpoons NH_4^+ + OH^-$$

} all bases

- What about these substances?
  - Washing soda = Na_2CO_3 (indicators say = base)
  - lemon juice = $C_6H_8O_7$ (indicators say = acid)

Proton Shuffle

Name: _____

Period: _____ Date: _____

Purpose: This activity will provide you with information to expand on your definition of acids and bases.

Procedure:

1. Sort the cards into three groups – acid, base and neutral.
2. Look for patterns within the three groups.
3. Sort the cards into smaller groups within each category.

Answer the following questions:

1. How did you sort the acids into smaller groups? Show the groups below – include each compound's name and formula.

Acids

I	II	III
H_2CO_3	HBr	$C_2H_4O_2$
H_3PO_4	HCl	CH_2O_2
H_2SO_4	HF	$C_2H_2O_4$
HNO_3		

2. List your reasons for placing the acids in these particular groups.

3. What do all of the acids have in common?

polar covalent bonding, have "acid" in their names

4. How did you sort the bases into smaller groups? Show the groups below – include each compound's name and formula.

Bases

I	II	III
KOH	NH_3	$NaHCO_3$
NH_4OH	C_5H_5N	
NaOH	CH_3NH_2	
$Mg(OH)_2$		

5. List your reasons for placing the bases in these particular groups.

6. What are two ways that a substance can form OH^- in solution?

by dissociation or rxn w/ H_2O

7. Explain why some of the compounds are bases when they do not have an OH^- in their chemical formula. act like bases because they remove H^+ from H_2O & leave OH^- behind

8. How did you sort the neutrals into smaller groups? Show the groups below – include each compound's name and formula.

Neutral Substances

I	II	III
KCl	$C_4H_8O_2$	H_2O
$NaNO_3$	C_2H_6O	
NaCl	C_3H_6O	
	CH_2O	

9. List your reasons for placing the neutral substances in these particular groups.

10. Excluding water, what is similar about all of the neutral substances? What causes a substance to be neutral? don't dissociated or if they do they don't make H^+ or OH^-

11. Why don't H^+ or OH^- ions come off of ethanol, ethyl acetate, acetone, and formaldehyde?

12. Would you predict HI to be an acid or a base? Explain.

acid

13. Water can act as an acid or a base. Explain why.

releases both H^+ & OH^-

14. Water can be an acid or a base, but it is still classified as a neutral substance. Explain. produces same amount of H^+ & OH^- which cancels each other out

15. Would you predict $Ca(OH)_2$ to be an acid or a base? Explain.

base

Making Sense:
The Arrhenius definition of acids and bases defines them as substances that release either H^+ or OH^-. How can we expand on this definition to include substances like methylamine, CH_3NH_2, and ammonia, NH_3?

If you finish early:
Ammonium chloride, NH_4Cl is an acid. Write an equation explaining what you think is going on in solution.

Making Sense Notes:

- What are some other characteristics of Acids, Bases, & Neutral substances?

	Composition	Bond Type	Dissociation
Acids:	nonmetals	polar covalent	release H^+
Bases	metal-nonmetal or nonmetals	ionic or polar covalent	releases OH^- or removes H^+ from H_2O
Neutral	metal-nonmetal or nonmetals	ionic or molecular covalent	doesn't dissociate or don't have H^+ or OH^-

- Can we expand our definition of acids & bases?

- Brønsted-Lowry definition of Acids & Bases
  - Acid: a substance from which a H^+ (proton) can be removed (aka proton donor)
  - Base: a substance that can remove a H^+ (proton) from another substance (aka proton acceptor)

- Can water act like an acid or base?

- Water can act like both an acid & a base!
  - Water as an Acid:

$$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$

NH_3: base — takes a H^+ from water & leaves behind OH^-

H_2O: acid — give away the H^+

NH_4^+: conjugate acid — (+) charge

OH^-: conjugate base — (−) charge

  - Water as a Base:

$$HNO_3 + H_2O \rightleftharpoons H_3O^+ + NO_3^-$$

HNO_3: Acid — proton donor

H_2O: base — proton acceptor

H_3O^+: conjugate acid — (+) charge

NO_3^-: conjugate base — (−) charge