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Macroscopic, particle and symbolic representations of aqueous reactions

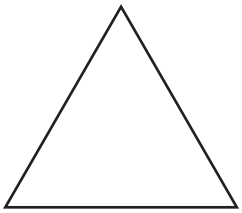
Name: _____ DS: _____

Learning Objective:	After completing this activity, you should be able to understand the difference between macroscopic, particle and symbolic representations of simple aqueous reactions (precipitation reactions).

Instructions: You will complete your own worksheet working in your small groups. Periodically, you will also be asked to give a response with your clicker.

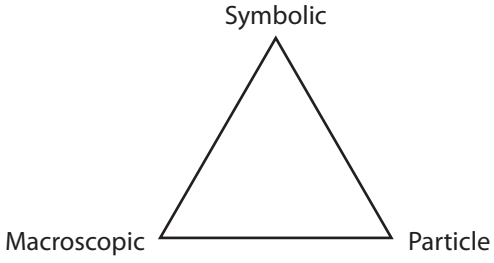
Part I: The three representations of a reaction

1. Complete the triangle shown with each type of representation – include a short definition.



Draw an arrow to the position where a balanced chemical equation would be placed.

2. For the reaction of hydrogen and oxygen to make water, what is the balanced chemical equation for this? Write this below on the triangle and label the type of representation that this is (macroscopic, particle or symbolic).



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3. What is the molecular or particulate representation for this reaction? Include this on your triangle (on number 3).

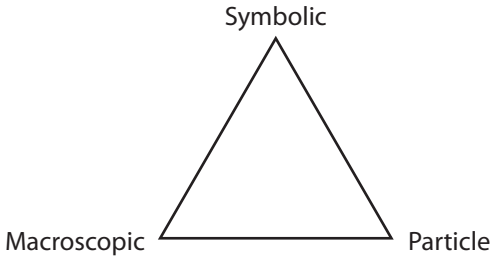
4. What is a macroscopic representation for this reaction? Include this on your triangle (on number 3).

Part II: Water as a solvent and solubility of ionic compounds

5. Draw one molecule of water. Identify any uneven charge distribution on the molecule showing this with a "+" and "–" sign.

   Add another water molecule and show how the molecules would interact based on the charges you assigned.

6. Complete the three representations for water as a liquid.



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7. The solubility table is given below. Discuss how to read the table.

Soluble Compounds	**Insoluble Exceptions**
Compounds containing alkali metal ions (Li^+, Na^+, K^+, Rb^+, Cs^+) and the ammonium (NH_4^+)	
Nitrates (NO_3^-), bicarbonates (HCO_3^-) and chlorates (ClO_3^-)	
Halides (Cl^-, Br^-, I^-)	Halides of Ag^+, Hg_2^{2+} and Pb^{2+}
Sulfates (SO_4^{2-})	Sulfates of Ag^+, Ca^{2+}, Sr^{2+}, Ba^{2+}, Hg_2^{2+} and Pb^{2+}
Insoluble Compounds	**Soluble Exceptions**
Carbonates (CO_3^{2-}), phosphates (PO_4^{3-}), chromates (CrO_4^{2-}) and sulfides (S^{2-})	Compounds containing alkali metal ions and the ammonium ion
Hydroxides (OH^-)	Compounds containing alkali metal ions and the Ba^{2+} ion

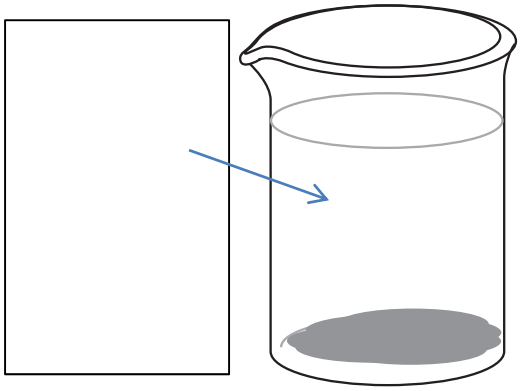
8. Assign the solubility of the compounds listed as **S**oluble (**S**) or **I**nsoluble (**I**).

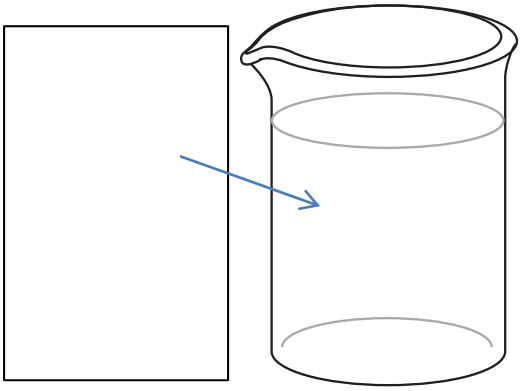
Na_2CO_3 _____ $Ca(HCO_3)_2$ _____

$PbCl_2$ _____ $Fe(NO_3)_3$ _____

$Al(OH)_3$ _____ $SrSO_4$ _____

9. Using the diagrams, which macroscopic representation is best for each compound (not saturated) listed in number 8? Write the name of the compounds in the box provided.





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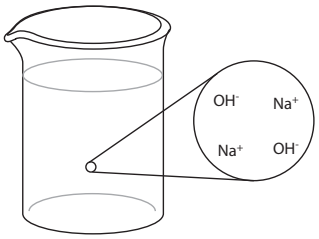
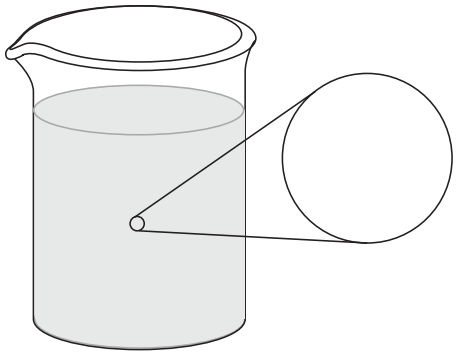
Sodium hydroxide is soluble in water. This is shown to the right.

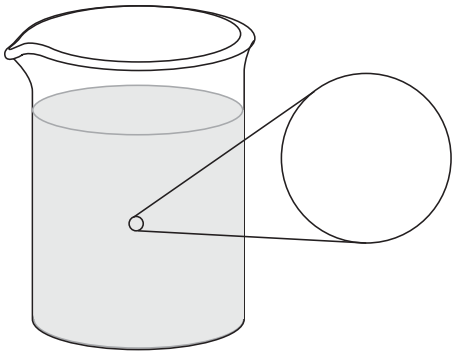


10. Using the same idea, show the ions are present in solution for each solution shown.

$Fe(NO_3)_3$



Na_2CO_3

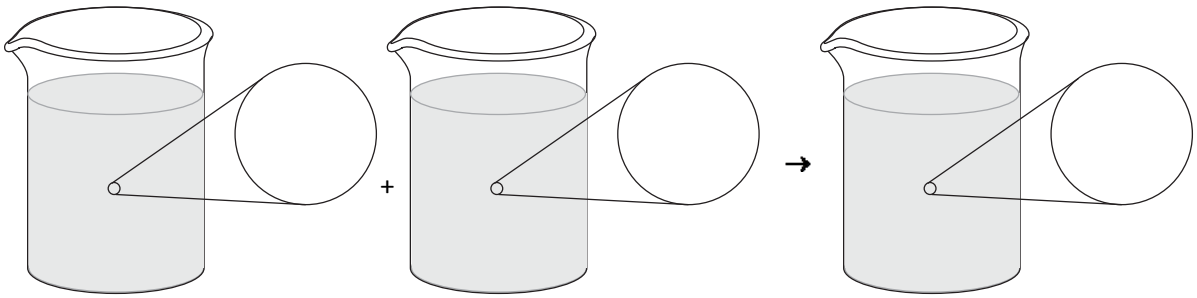


Part III: Aqueous reactions – precipitation reactions

11. When the solutions in number 10 are combined, what possible new ionic compounds can form?

12. What is the solubility of these compounds?

13. Show the reaction on the macroscopic and particulate-level using the beakers below. Add any solids as needed.



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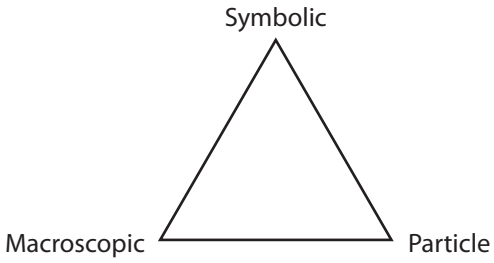
14. Show the balanced (total or molecular) equation for this precipitation reaction. (Remember, this is a symbolic representation.)

15. Show all ionic compounds that are soluble as dissociated ions in your balanced reaction. This is the total ionic equation.

16. Identify and cancel the spectator ions. This is the net ionic equation.

17. Complete the representation triangle below for this reaction. Where do the total (or molecular) equation, total ionic and net ionic equations go?



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More practice (take home):

1. For each of the combinations, show all representations including three symbolic representations. If no reaction occurs, write "no reaction"

    a. Silver nitrate ($AgNO_3$) and potassium hydroxide (KOH)

    b. Magnesium bromide ($MgBr_2$) and iron(III) sulfate ($Fe_2(SO_4)_3$)

2. What would precipitate only lead in a solution of Fe^{3+}, Cu^{+}, Pb^{2+}, and Ba^{2+}? Show all representations including three symbolic representations of this reaction.