



Name: _____ Date: _____

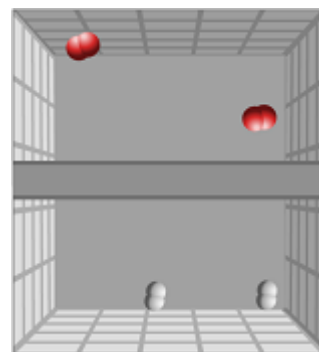
Student Exploration: Limiting Reactants

Prelab Questions:

Imagine you and your friends are making hot dogs. A complete hot dog consists of a wiener and a bun. At the store, you buy four packages of eight wieners and three bags of 10 buns.

1. How many total hot dogs can you make? _____
2. Which ingredient limited the number of hot dogs you could make? _____
3. Which ingredient will you have leftovers of? _____

Just as ingredients can be put together to make a new food, substances can combine during a **chemical reaction** to produce new substances. The substances that undergo change are called **reactants**. The new substances are **products**.



To begin, make sure **H₂ + O₂ becomes H₂O** is selected. The small "2" in H₂, O₂, and H₂O is a subscript. Subscripts represent the number of atoms in a molecule.

1. Use the sliders to set the number of **O₂ molecules** to 1 and **H₂ molecules** to two.
 - A. How many hydrogen molecules (H₂) are there? _____ Hydrogen atoms? _____
 - B. How many oxygen molecules (O₂) are there? _____ Oxygen atoms? _____
2. How many H₂O molecules do you think will form when these three molecules react?

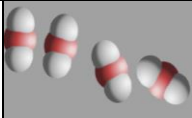
3. Click **Play** (▶). How many H₂O molecules actually formed? _____
 - a. Write the balanced equation for the synthesis reaction of water
4. If you want to make 6.02×10^{23} molecules of water using this reaction, how many of each reactant will you need?

	How many molecules will you need?	How many moles is this?
H ₂		
O ₂		



- a. If you had 6 moles of H_2 , 4 moles of O_2 , how many moles of H_2O could you make? Would you have any left-over pieces?
5. The coefficients in a chemical reaction can tell us the number of _____ of a substance and the number of _____ of a substance.

Sometimes during a chemical reaction, one type of reactant will be used up before the other reactants. This reactant is the **limiting reactant**. Using the Gizmo, you can determine which reactant is limiting in various scenarios.

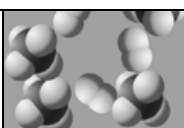
Activity A: Water reaction	<u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> • Make sure $H_2 + O_2$ becomes H_2O is selected. • Click Reset (↺). 	
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Goal: Identify a limiting reactant.

- Count: H_2O is the chemical formula for water. In order to produce a single molecule of water, how many hydrogen atoms are needed? _____ Oxygen atoms? _____
- Predict: Set the number of O_2 molecules to five and the number of H_2 molecules to eight.
 - How many oxygen atoms are present? _____ Hydrogen atoms? _____
 - How many water molecules could form from these reactants? _____
 - After the molecules react, which reactant will be left over? _____
 - Which reactant will be the limiting reactant? _____
 - Click **Play** and wait until **Reaction complete** is shown. What happened? _____

- Test: Click **Reset**. Set the number of O_2 molecules to 10.
 - How many molecules of hydrogen molecules (H_2) will be needed for there to be no excess reactants? _____ Use the slider to set the number of H_2 molecules to this value.
 - How many water molecules will be formed? _____
 - Click **Play**. What happened? _____



Activity B: Methane reaction	<u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> • Select C + H₂ becomes CH₄. 	
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Goal: Predict the results of a chemical reaction.

- Count: CH₄ is the chemical formula for methane. In order to produce a single molecule of methane, how many carbon (C) atoms are needed? _____ Hydrogen atoms? _____
- Write the balanced chemical equation for the synthesis of methane
 What do the coefficients tell us about the substances?
- Predict: Set the number of **C atoms** to 14 and the number of **H₂ molecules** to 10.
 - How many total hydrogen atoms are there? _____
 - How many methane molecules could form from these reactants? _____
 - After the atoms react, which reactant will be left over? _____
 - Which reactant will be the limiting reactant? _____
 - Click **Play** and wait until **Reaction complete** is shown. What happened? _____

- Test: Click **Reset**. Set the number of **C atoms** to seven.
 - How many hydrogen molecules (H₂) will be needed for there to be no excess reactants? _____ Use the slider to set the number of **H₂ molecules** to this value.
 - How many methane molecules will be formed? _____
 - Click **Play**. What happened? _____
- Solve: For each **chemical equation** below, write the number of product molecules that will form from the reaction. Then, circle the limiting reactant. (Note: The **coefficients** in front of the reactants indicate the number of reactant molecules or atoms present.)
 - 5C + 6O₂ → _____ CO₂
 - 4Na + 8Cl₂ → _____ NaCl
 - 3CO₂ + 4H₂O → _____ H₂CO₃
 - 7N₂ + 9H₂ → _____ NH₃
 - 10Zn + 16HCl → _____ ZnCl₂ + _____ H₂

