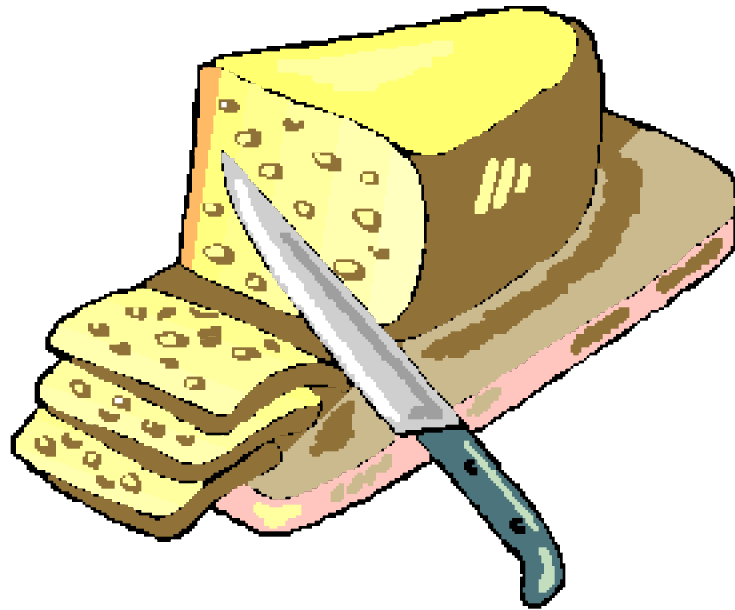
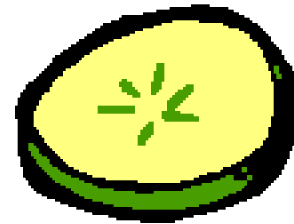
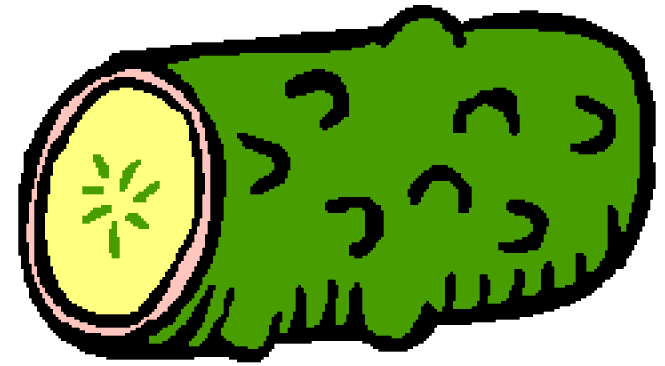
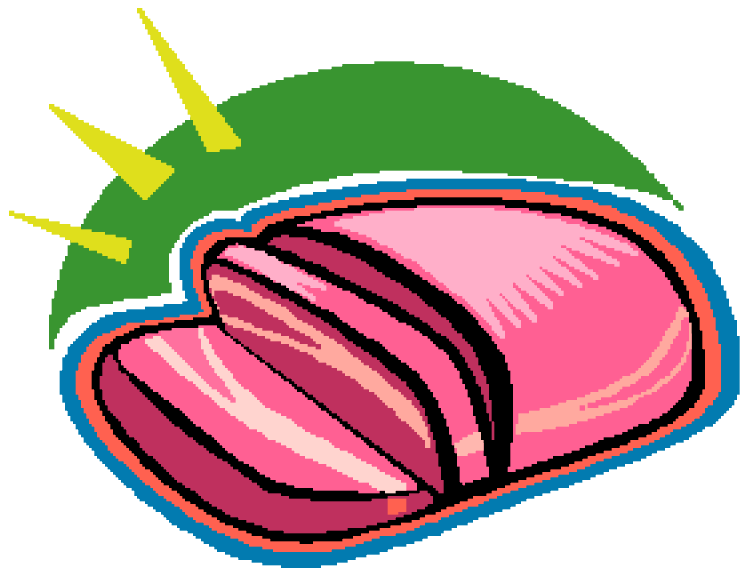


# Limiting Reagents

- Suppose you given the job to make a ham and cheese sandwich.
- The instructions you have require 2 slices of bread, 2 slices of cheese, one slice of ham and 3 pickles for each sandwich.



# Limiting Reagents

After collecting all the ingredients you find you have:

- 11 slices of bread
- 8 slices of cheese
- 9 slices of ham
- 18 pickles

How many sandwiches can you make?

# Limiting Reagents

With the 11 slices of bread you can make 5 sandwiches with one slice left over.

With 8 slices of cheese you can make 4 sandwiches.

With 9 slices of ham you can make 9 sandwiches.

With 18 pickles you can make 6 sandwiches.

The most number of sandwiches you can make is 4 - the cheese is the limiting ingredient.

The remaining items are excess ingredients.

# Limiting Reagents

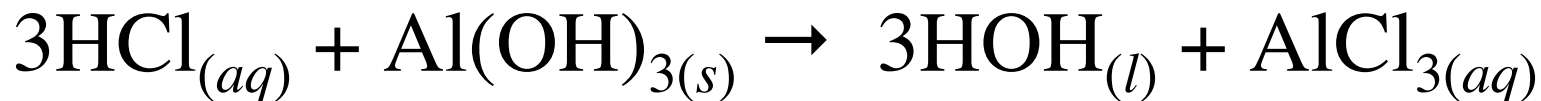
- You will have 3 slices of bread left.
- The cheese will be gone.
- 5 slices of ham will still be on the plate.
- 6 pickles will be left (in case you want to snatch one or two before you start).
  
- Chemical reactions work in the same way only with chemistry we usually measure mass instead of counting molecules.

# Limiting Reagents

- What happens when the starting materials (reagents or reactants) in a chemical reaction don't exactly "match up" when making the products?

What mass of water will be produced when 34.6 mL of 2.36 M hydrochloric acid reacts with 1.34 grams of aluminum hydroxide?

What is left over?



# Limiting Reagents

Start with what we can pick up and carry around - in this case 2 quantities:

$$34.6 \text{ mL HCl} \times \frac{2.36 \text{ moles HCl}}{1000 \text{ mL HCl}} \times \frac{3 \text{ moles HOH}}{3 \text{ moles HCl}} \times \frac{18.0152 \text{ g HOH}}{1 \text{ mole HOH}} =$$

1.47 grams of water

$$1.34 \text{ g Al(OH)}_3 \times \frac{1 \text{ mole Al(OH)}_3}{78.003 \text{ g Al(OH)}_3} \times \frac{3 \text{ moles HOH}}{1 \text{ mole Al(OH)}_3} \times \frac{18.0152 \text{ g HOH}}{1 \text{ mole HOH}} =$$

0.928 grams of water

# Limiting Reagents

The “correct” answer is 0.928 grams of water.

The aluminum hydroxide is the limiting reagent.

The hydrochloric acid is the excess reagent - it will be left over.

[Limiting Reagents Simulation](#)