M5 Scope and Sequence

1 Unit 4. Chemical Reactivity

1.1 Acid-Base Chemistry

Introduction Powerpoint presentation: M5 acids bases & salts - introduction.ppt

1.1.1 Definitions & Properties

PowerPoint slide: M5 acids bases & salts I: Definitions Properties & Rxns

Worksheet: acids & bases definitions & props - DVD wkst.

Demonstrate a discrepant event: Magical beakers.

7 400-mL beakers with the following

- 1st beaker: distilled water and universal indicator solution
- 2nd beaker: 1 drop of 1M HCl
- 3rd beaker: 2 drops of 1M HCl
- 4th beaker: 1 drop of 1M NaOH
- 5th beaker: 1 drop of 1M NaOH
- 6th beaker: 2 drops of 1M NaOH
- 7th beaker: 50 mL of pH 7 buffer solution

Have them work through the questions as they watch Classroom Video Education with vision DVD: Acids and Bases (30 minutes).

After completing the DVD and worksheet, have them answer the questions at the back of the slides.

The next lesson can then be the following experiment:

Have them conduct the following reactions, record observations, write equations etc. (must include a test for hydrogen and its description)

Expt: Properties of acids and bases

- metals and acids
- metal oxide acids
- metal carbonates and acids
- metal hydroxide solution and acids
- metal hydroxide solution and ammonium salt

In one of each of the first three tests, have them add a drop or two of universal indicator solution in the acid and then

- add the metal, and record the change in color.
- add the metal oxide and metal carbonate little at a time making note of the change in color until no more oxide or carbonate dissolves in the water
- In the 4th test tube start with some hydroxide solution, add a drop or two of universal indicator solution and then add the acid dropwise making a note of the change in color.

1.1.2 Acids & Oxides

PowerPoint slide: M5 acids bases & salts II: Acids & Oxides

Worksheet: Acids & oxides - wkst.

Demonstrate the strength of concentrated strong acid by reacting

- conc. Sulfuric acid,
- glacial ethanoic acid,
- dilute sulfuric acid, and
- dilute ethanoic acid with sugar

Demonstrate difference in conductivity of strong and weak acids and bases.

Demonstrate the action of concentrated strong acid on sugar and cotton.

Demonstrate the different conductivity of strong and weak acids and bases.

Discrepant event: Smoke blown through glass.doc (location: ..\discrepant events\acid base)

Experiment: Strength of Acid and Properties of oxides (give only the details of station set-up for them to organize the materials into a table so that they can collect and present the observations effectively.)

Have them perform an experiment where they test

- pH of strong and weak acid
- pH of strong and weak bases
- reaction of metal oxides with acids
- demonstrate the production of sulfur dioxide and the resulting acidic solution
- test pH of solution (using universal solution) of other non-metal oxides available in the lab
- test pH carbonated water (using universal solution)
- blow into test tube of distilled water with a drop or two of universal indicator solution until distinct color change

Demonstrate the acidity of non-metal oxide by burning sulfur in a gas jar.

Draw attention to the acidity of carbonated water—ascribe it to dissolved carbon dioxide.

Acidity and Basicity of oxide pattern: VHS Science Bank. Raw Materials. Oxygen and Oxides. 5:40-8:20.

Have a look at the results of acidity and basicity tests on different cleaning agents and everyday substances that they tested in the last experiment.

Assessment task: Science and our World Essay on Acid rain.

Investigation assessment: The bakery murder mystery

1.1.3 Salts

PowerPoint slide: M5 acids bases & salts III: Salts

Worksheet: salts - wkst.

Discrepant events: Magic Powders (to be found: ..\discrepant events\mixtures)

Have some important salts on display and talk to them about their use.

Begin with the idea of preparation of salts, and then the other methods.

Explain what solubility means. Show video animations of what solubility means:

- Video 1: DissolutionofNaClinWater (Location: stoichiometry/solution stoichiometry/)
- Video 2: dissolution at particle level (Location: stoichiometry/solution stoichiometry/)

Then have them perform the experiment on precipitation reactions: Precipitation reactions and solubility of salts (instruction & worksheet combo).

Next move on to Preparation of soluble salts.

Preparation of soluble salts:

1. Titration method: Show video Acidbasetitration ((Location: stoichiometry/solution stoichiometry/). Then show the animation: Acid-BaseTitrationActivity.html (Location: stoichiometry/solution stoichiometry/) adding 1 ml of base at a time.
2. Describe performance of an acid-reaction with a solid (such as a metal, metal oxide, metal carbonate or metal hydroxide)

Then have them perform two experiments where they prepare one soluble salt. Have some use the method of titration while others use the method of reacting either an oxide or carbonate with an acid.

**********Leave identification tests for towards the end of the second six week session. Cover it if there is enough time. **********

1.2 Stoichiometry

1.2.1 Relative Mass

Might be better to start with the grains of sugar in a sample of sugar challenge and then lead on to relative atomic mass, molar mass and molar volume. Feb. 2, 2010.

PowerPoint Slides: M5 Stoichiometry I: Relative Masses (already covered in M4).

Show them the video clip made in BMIS with form 5 students and their gunpowder mixture. Tell them that they will in the course of the next several lessons learn the necessary quantitative chemistry to be able to work with the chemicals required to make gunpowder and then go to make a "bullet" and test it out.

Discrepant event: Hydrogen-oxygen bottle cannon.

Demonstrate explosive reaction between hydrogen and air mixtures in a water bottle and tell them they will learn about the reason for the explosion.

- 3× 500-ml corked bottle with hydrogen and air mixture in the following amounts:
- 80 ml hydrogen and 410 ml air (already labeled "Bottle #1") (H_2:O_2 volumetric ratio =1:1) – way way too loud!!
- 140 ml hydrogen and 360 ml air (already labeled "Bottle #2") (H_2:O_2 volumetric ratio =2:1) – way way WAY too loud!!)
- 332 ml hydrogen and 166 ml oxygen (already labeled "Bottle #3") (H_2:O_2 volumetric ratio =2:1) – too loud to be conducted in the lab; took it outside!!)

Change to the following:

- 3× 500-ml corked bottle with hydrogen and air mixture in the following amounts:
- 20 ml hydrogen and 480 ml air (already labeled "Bottle #1") (H_2:O_2 volumetric ratio =1:5)
- 45 ml hydrogen and 455 ml oxygen (already labeled "Bottle #2") (H_2:O_2 volumetric ratio =1:2)
- 80 ml hydrogen and 410 ml air (already labeled "Bottle #3") (H_2:O_2 volumetric ratio =1:1)

Demonstrate the explosiveness of firecracker.

The tin can-tennis ball cannon:

Volume of tin can = 350 ml

Volume of hydrogen = 90 ml

Gives a mixture of approximately 2:1 hydrogen to air mixture.

Tested and found to give a reasonably range. The range can be easily determined by measuring where the ball lands. Because the ball will be wet, it will make a splash where it lands.

1.2.2 Mole Concept

PowerPoint Slides: M5 Stoichiometry II: Mole Concept.

Worksheet. Mole concept – wkst.

Start with activity on estimating the number of sugar cubes in a 150 ml of sugar.

After completing the concept of Mole, give out Astounding Numbers (Chemistry for Gifted and Talented worksheet) to those interested.

(Include the following as well: To get across the concept of the mole have them estimate the number of sand grains on photo of an area they know. Then have them estimate the sand grains in the sahara desert in northern Africa.)

To get across the idea that a mole of substance is different mass of substances, show them a mole of as many different samples of substances as we have in the store room.

1.2.3 Mass Relationship

PowerPoint Slides: M5 Stoichiometry III: Mass relationships.

Worksheet: mass relationships – wkst.

1.2.4 Limiting & Excess Reagent

PowerPoint Slides: M5 Stoichiometry IV: Limiting and Excess reagents

Demostrate the following

- reaction between different proportions of hydrogen and oxygen mixtures in 300 mL plastic bottles with a rubber bung at the mouth and a small hole for the burning splint.
- Reaction between different amounts of sodium hydrogencarbonate but the same amount of vinegar in a conical flask fitted with balloons at the mouth.

Then move on to the worksheet (limiting and excess reagent – wkst).

1.2.5 Solution Stoichiometry

PowerPoint Slides: M5 Stoichiometry V: Solution Stoichiometry

Worksheet: solution stoichiometry.

And then move on the preparation and testing of the bullet to wrap up the topic.
******MAYBE THE GUNPOWDER EXPERIMENT COULD BE AN ASSESSMENT TASK!!!!******

Worksheet: gunpowder.

Other Assessment tasks:

Planning lab: Identification of an unknown substance (see IGCSE paper 5 and 6 for examples that they can get practice with)

Planning lab: Salt Preparation (after quantitative chemistry so that they can determine the yield and percent purity; again, see IGCSE paper 5 and 6 for examples.)

Unit 5. Redox Reaction

1.3 Patterns of reactivity

Introduction: Introduction Slides

Discrepant event: Video of reaction of aluminum powder with copper oxide.

PowerPoint slides:

- M5 Patterns of reactivity I: Displacement Reactions;
- M5 Patterns of reactivity II: Reactivity Series

Worksheet:

- properties of metals & nonmetals – wkst
- reactivity 2: displacement reactions
- reactivity 1: The reaction between metals and acids

Experiment

Instructions sheet: tendency of metals to form ions - expt. (Need to add more details. Feb. 4, 2010)

Show video first so that they have an idea of what the experiment is about and what to expect. It's one of the Science Bank Videos.

The instruction sheet is based on the following displacement reactions they carry out:

- metals (Mg, Fe, Al, Zn, Cu) and salt solutions of other metals
- metal and water/steam
- metal and acid
- carbon and copper oxide

Set it out like the other experiment where there are different stations (see Acids, Bases and Salts experiment details). Give them the list of materials to be found at each station and ask them to prepare a table in which they can record their observations. Demonstrate one test. Write out the equation for the reaction and then ask them to figure out the equation for the rest of the reactions.

Assessment task:

Write up: Rubidium and Ceasium in water video. Show videos of both real reaction of Rubidium and Ceasium with water and Brainiac videos. Point out that they are displacement reactions. Did the Brainiac Scientists use real Rubidium and Ceasium? (If they haven't already done this in M4.)

OR show videos of thermit reaction and aluminum and copper oxide reactions. Then ask them to explain as much of the observations as possible.

PowerPoint Slides: M5 Patterns of reactivity III: Stability of Compounds

Worksheet: Not necessary; demonstration based.

Demonstration of the thermal decomposition of the following compounds

- lead bromide
- sodium or potassium bromide
- potassium nitrate

- copper(II) or iron(II) nitrate
- decompose a sulfate (use a moist blue litmus paper to show that decomposition has taken place)
- silver carbonate

1.4 Assessment tasks

experimental design:

1. Determine the position of the unknown metal in the reactivity series (need to create instruction sheet for it).

2. Investigate the effect of one factor on rusting of iron. (DON'T ASSIGN THIS. SEE BELOW—DISCREPANT EVENT INVOLVES THIS REACTION!)

1.5 Redox Reactions

Discrepant events:

1. Rusting of iron. Invert, in a trough of water, a measuring cylinder with wet steel wool stuck to the bottom and water up to the 100-ml mark. Leave for 4-5 days and have the students record observations.

Have a variety of food samples

- Canned food
- Vacuum sealed bottled food
- Food in plastic bag in nitrogen environment

PowerPoint slides: M5 Redox Reactions I: Definitions

Worksheets:

- redox rxns definitions – wkst
- reduction and oxidation - redox reactions - wkst

After completing the oxidation number definitions, show the following videos or reactions and ask them to first record their observations and then given the equation, see if they can work out why they would be classified as redox reactions. And then have them also identify reducing and oxidizing agents.

- Video of Al and CuO reaction (TISA 2008-9)
- Video of zinc and sulfur reaction (TISA 2007-8 IB2 or M2)
- Gunpowder video (BMIS) and give them the equation
- Demonstrate acidity of wine by testing with a blue litmus paper
- Show video of fire cracker shooting can into the air
- Decomposition of ammonium dichromate(VI)
- Video of burning sugar (TISA M2 2007-8)
- Could even show thermit reaction video
- if time permits, show videos of combination reactions when looking at the final question (question no. 11)

Discrepant event: Demonstrate variable oxidation states of transition metals and redox reaction. Transition metal & redox (under Demos & simulation/Redox)

PowerPoint slides: M5 Redox Reactions II: Oxidation state

Worksheet:

- oxidation # rules – wkst
- Prentice Hall 20-1 practice problems

One world Essay: Heavy metal pollution
(Alternative writing assignment: Chemistry of a reaction)

1.6 Assessment task

One world Essay: Hydrogen as a fuel

2 Unit 6. Rate of Reaction

Start with the demos and experiments below. (Worksheet: Reactions and their rates – demo wkst.)

- Sodium and water
- Magnesium and sulfuric acid
- Zinc and copper sulfate
- Lead(II) nitrate and potassium iodide. Use very very dilute potassium ioide in a tall measuring cylinder and add drops of lead(II) nitrate.
- Hydrogen and oxygen mixture
- Zinc and sulfur mixture
- Aluminum and iron(II) oxide reaction
- Wet steel wool in gas jar inverted over trough of water

$2Na(s) + 2H2O(l) \rightarrow 2NaOH(aq) + H2(g)$

$Mg(s) + H2SO4(aq) \rightarrow MgSO4(aq) + H2(g)$

$Zn(s) + CuSO4(aq) \rightarrow ZnSO4(aq) + Cu(s)$

$AgNO3(aq) + NaCl(aq) \rightarrow AgCl(s) + NaNO3(aq)$

$2H2(g) + O2(g) \rightarrow 2H2O(l)$

$Zn(s) + S(s) \rightarrow ZnS(s)$

$2Al(s) + Fe2O3(s) \rightarrow Al2O3(s) + 2Fe(s)$

$4Fe(s) + 3O2(g) \rightarrow 2Fe2O3(s)$

$4Al(s) + 3O2(g) \rightarrow 2Al2O3(s)$

Type of reactions scope and sequence
Have them perform reactions between the following chemicals

- Zn with Iodine, aluminum with bromine, sodium with chlorine, Zn and Sulfur (in a small test tube), Fe and Sulfur (in a medium sized test tube—heat and then when reaction initiated, remove from flame and observe), magnesium with oxygen
- Hydrogen with oxygen (get a mixture of pure oxygen and hydrogen)
- Burn charcoal in boiling tube connected to a test tube with lime water

Have them perform some precipitation and decomposition reactions
Precipitation Reactions

- Experiment involving reactions of nitrates with sulfate and determining the solubility rules
- Decomposition reactions
- Decomposition of nitrates and hydroxides

Have them perform and observe the following displacement reactions but not really go over the theory behind them all.

- Charcoal and copper oxide in a test-tube and dip in cold water
- Charcoal and lead oxide in a test tube and dip in water
- Metal and solution of another metal salt
- Metal and acid

Demonstrate the following reactions:

- Burn charcoal above decomposing potassium chlorate(V)
- sulfur with oxygen
- Thermite
- Methane and copper oxide
- Steam and magnesium
- Group 1 metals and water

An aside…
In terms of the states of the reacting substances, you should have noticed that a reaction may involve one of the following
Two solids, for example displacement reaction between a metal (Al) and oxide of a less reactive metal (Fe_2O_3).
A solid and a liquid, such as those between metal or metal oxide or metal hydroxide or carbonate and acid etc.
A solid and a gas, such as those between steam and metal or hydrogen and metal oxide or a solid element and a gaseous element.
Two liquids or solutions, such as that between solutions of a base and an acid or two salt solutions (which you haven't learned about but will encounter soon) etc.
A liquid and a gas, such as that between acidic gas and water etc.
Two gases such as that between ammonia and hydrogen chloride or that between hydrogen and oxygen.

2.1 Collision Theory

PowerPoint slides: M5 Rate of Rxn I: collision theory

Worksheets:

- collision theory – wkst
- Reactions and their Rates - demo wkst

2.2 Speed of reaction

PowerPoint slides: M5 Rate of Rxn II: speed of reaction 1

PowerPoint slides: M5 Rate of Rxn II: speed of reaction 2

Worksheet:

- Following progress of reaction – wkst

Following progress of reaction starts with a demonstration of a reaction between marble chips and hydrochloric acid in a conical flask.

The first one should use big chips and the second one very very small chip.

They record observations in the worksheets

They should be asked to simply record the observation.

Worksheets:

- Speed of reaction: determining speed (rate) of a reaction – wkst

Then go on to perform experiments and analyze data for rate of reaction.