CURRICULUM CONTENT

1. How fast are reactions?

- Describe the effect of concentration, particle size, catalysts (including enzymes), and temperature on the rate (speed)reactions
- Describe a practical method for investigating the rate (speed) of a reaction involving gas evolution
- Describe the application of the above factors to the danger of explosive combustion with fine powders (e.g., flour mills) and gases (e.g., mines)

2. Production of Energy, and Reversible Reactions

- Describe the production of heat energy by burning fuels
- Describe hydrogen as a fuel
- Describe radioactive isotopes, such as 235 U, as a source of energy
- Describe the idea that some chemical reactions can be reversed by changing the reaction conditions Limited to the effects of heat on hydrated salts including hydrated copper(II) sulfate and hydrated cobalt(II) chloride.

3. The behavior of metals

a) Properties of Metals

- Describe the general physical and chemical properties of metals
- Explain why metals are often used in the form of alloys
- Identify representations of alloys from diagrams of structure

b) Reactivity Series

- Place in order of reactivity: potassium, sodium, calcium, magnesium, zinc, iron, (hydrogen), and copper, by reference to the reactions, if any, of the metals with
  – water or steam
  – dilute hydrochloric acid and the reduction of their oxides with carbon

4. Making use of metals

- Describe the ease in obtaining metals from their ores by relating the elements to the reactivity series
- Describe the essential reactions in the extraction of iron from hematite
- Describe the conversion of iron into steel using basic oxides and oxygen
- Name the uses of aluminum:

- in the manufacture of airplanes because of its strength and low density
- in food containers because of its resistance to corrosion
- Describe the idea of changing the properties of iron by the controlled use of additives to form steel alloys
- Name the uses of mild steel (car bodies and machinery) and stainless steel (chemical plant and cutlery)

5. Air and water

- Describe chemical tests for water using cobalt(II) chloride and copper(II) sulfate
- Describe, in outline, the treatment of the water supply in terms of filtration and chlorination
- Name some of the uses of water in industry and in the home
- Describe the composition of clean air as being approximately 79% nitrogen, 20% oxygen and the remainder as being a mixture of noble gases, water vapor, and carbon dioxide
- Name the common pollutants in the air as being carbon monoxide, sulfur dioxide, oxides of nitrogen, and lead compounds
- State the source of each of these pollutants:
  - carbon monoxide from the incomplete combustion of carbon-containing substances
  - sulfur dioxide from the combustion of fossil fuels that contain sulfur compounds (leading to "acid rain"—see section 13)
  - oxides of nitrogen from car exhausts
- State the adverse effect of common pollutants on buildings and on health

6. Non-metals

- Describe the essential conditions for the manufacture of ammonia by the Haber process including the sources of the hydrogen and nitrogen, i.e. hydrocarbons or steam and air
- Describe the carbon cycle, in simple terms, to include the processes of combustion, respiration and photosynthesis
- Describe the need for nitrogen-, phosphorus- and potassium-containing fertilizers
- Describe the displacement of ammonia from its salts
- State that carbon dioxide and methane are green house gases and may contribute to climate change
- Describe the formation of carbon dioxide:
  - as a product of complete combustion of carbon containing substances

- as a product of respiration
- as a product of the reaction between an acid and a carbonate
- from the thermal decomposition of a carbonate
- Name some sources of sulfur
- Name the use of sulfur in the manufacture of sulfuric acid
- Name the uses of sulfur dioxide as a bleach in the manufacture of wood pulp for paper and as a food preservative (by killing bacteria)
- Describe the manufacture of sulfuric acid by the Contact process, including essential conditions
- Describe the properties of dilute sulfuric acid as a typical acid

7. Organic chemistry

- Name and draw the structures of methane, ethane, ethene, ethanol, ethanoic acid and the products of the reactions Alkanes, Alkenes, Alcohols
- State the type of compound present, given a chemicalname ending in *-ane, -ene, -ol,* or *-oic acid*, or a molecular structure
- Describe the properties of alkanes (exemplified by methane) as being generally unreactive, except in terms of burning
- Describe the bonding in alkanes
- Describe the manufacture of alkenes and of hydrogen by cracking
- Distinguish between saturated and unsaturated hydrocarbons
  - from molecular structures
  - by reaction with aqueous bromine
- Describe the formation of poly(ethene) as an example of addition polymerization of monomer units
- Describe the formation of ethanol by fermentation and by the catalytic addition of steam to ethene
- Describe the properties of ethanol in terms of burning
- Name the uses of ethanol as a solvent and as a fuel

8. Polymers

- Describe macromolecules in terms of large molecules built up from small units (monomers), different macromolecules having different units and/or different linkages
- Name some typical uses of plastics and of man-made fibres
- Describe the pollution problems caused by non-biodegradable plastics

- Deduce the structure of the polymer product from a given alkene and vice versa
- Describe the formation of nylon (a polyamide) and *Terylene* (a polyester) by condensation polymerization, the structure of nylon and the structure of *Terylene*
- Name proteins, fats and carbohydrates as the main constituents of food
- Describe proteins as possessing the same (amide) linkages as nylon but with different units
- Describe the structure of proteins
- Describe the hydrolysis of proteins to amino acids (Structures and names are **not** required.)
- Describe fats as esters possessing the same linkage as *Terylene* but with different units
- Describe soap as a product of hydrolysis of fats
- Describe complex carbohydrates in terms of a large number of sugar units, considered as HO OH , joined together by condensation polymerisation
- Describe the acid hydrolysis of complex carbohydrates (e.g. starch) to give simple sugars
- Describe the fermentation of simple sugars to produce ethanol (and carbon dioxide)
- Describe, in outline, the usefulness of chromatography in separating and identifying the products of hydrolysis of carbohydrates and proteins