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ABSTRACT

Two-column objectives are listed for an integrated science curriculum (grades K-12), often subheaded according to science area (biology, general science, physical science) and grade level. The focus of grades K-6 is an acquaintance of the student to: (1) the study of matter, its states, characteristics and properties, (2) structure of the atom, and (3) transformation of matter. Grade 7 interrelates topics of the nitrogen cycle, resource conservation, biological control, and photosynthesis. Grades 8-11 contain purely physical science objectives. Grade 11 relates chemistry and physics to the study of living things by grouping objectives for studying atomic structure, biochemical models, and enzyme-substrate reactions. (CS)

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This Articulated Curriculum is being printed and bound in this manner to provide for on-going revision. This also serves as evidence of work completed during Phase III of Project SEARCH.

SCIENCE

K - 12

CONSERVATION OF MATTER

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August 1975

MRS. ROSE DANELLA and NORMAN I. SIEGEL, both former Board Members deserve special mention for all their efforts on behalf of Project SEARCH.

UTICA CITY SCHOOL DISTRICT
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Utica, New York 13501

SCIENCE

CONSERVATION OF MATTER

The student will know:	The student will:
- that there are many sizes and shapes of all living and non-living things.	- orally list large, medium, and small living and
- that moving things, people and animals make sounds.	- identify sounds made by a selection of moving
- that there are three states of matter.	- list the three states of matter orally. (solid gas).
- that all things are composed of matter.	- identify the composition of a variety of materi
- that forms of energy-sound, heat, and light-affect matter.	- list several things that are changed by heat, l sound.
- that our world is made of many kinds of matter.	- identify a gas, liquid, solid.
- that matter has three states-solid, liquid gas.	- classify matter from a given list. i.e. hard, s
- that solids have definite volume and shape; liquids have volume but take shape of container; gases have no volume or shape.	- categorize materials as solids, liquids and gas determine which have volume and shape.
- that many kinds of matter can be grouped into "families" i.e. wood, metal, etc.	- orally define necessary terms.

CONSERVATION OF MATTER

Grade K

The student will:
- orally list large, medium, and small living and non-living things.
- identify sounds made by a selection of moving things.
- list the three states of matter orally. (solid, liquid, gas).

Grade 1

- identify the composition of a variety of materials.
- list several things that are changed by heat, light, and sound.

Grade 2

- identify a gas, liquid, solid.
- classify matter from a given list. i.e. hard, soft.
- categorize materials as solids, liquids and gases, and determine which have volume and shape.
- orally define necessary terms.

- that matter is anything that has weight and occupies space.	- define matter in writing.
- that matter may be classified in terms of properties.	- make charts classifying objects according to the properties.
- that matter can change from one form to another.	- identify how matter can change from one form to e.g. melt ice, boil water, freeze water.
- that matter is made up of molecules and atoms.	- classify matter according to its state.
- that light, heat and sound affect the motion of molecules in matter.	- perform an experiment showing how matter can ch one form to another. (e.g. melt ice, boil water water).
- that in chemical change, atoms react to produce change in the molecules.	- chart 3 forms of matter and explain each.
- that matter exists as solids, liquids and gases.	- define the nature of matter as it exists in a s liquid, and a g.s.
- that matter is made of particles and that matter can be changed from one form to another.	- write a definition for matter indicating that i of particles and may be changed from one form t
- the three basic states of matter-solid, liquid, and gas.	- classify materials under each heading.
- that in chemical or physical changes, the total amount of matter remains unchanged.	- list changes that occur when performing experi
- the characteristics of matter: cannot be destroyed, cannot be created, and can be changed into energy.	- define the characteristics of matter indicating cannot be destroyed, created, or changed into e

Grade 3

at has weight and	- define matter in writing.
ied in terms of	- make charts classifying objects according to their physical properties.
m one form to	- identify how matter can change from one form to another, e.g. melt ice, boil water, freeze water.

Grade 4

molecules and atoms.	- classify matter according to its state.
affect the motion of	- perform an experiment showing how matter can change from one form to another. (e.g. melt ice, boil water, freeze water).
toms react to ecules.	- chart 3 forms of matter and explain each.
ds, liquids	- define the nature of matter as it exists in a solid, a liquid, and a gas.

Grade 5

rticles and that one form to	- write a definition for matter indicating that it is made of particles and may be changed from one form to another.
matter-solid,	- classify materials under each heading.
al changes, the ains unchanged.	- list changes that occur when performing experiments.
ter: cannot be ed, and can be	- define the characteristics of matter indicating that matter cannot be destroyed, created, or changed into energy.

- that our conservation of matter will affect future generations.	- report on how waste of matter could affect futu	tter will affect - report on how waste of matter could affect future generations.
		Grade 6
- the states of matter.	- describe three different states of at least fiv stances.	- describe three different states of at least five sub-stances.
- the properties of matter.	- define the properties of matter e.g. inertia, volume, porosity.	- define the properties of matter e.g. inertia, mass, density, volume, porosity.
- the make-up of matter.	- describe the structure of an atom, with a simpl	- describe the structure of an atom, with a simple illustration
- the names and data of the 15 most commonly occuring elements.	- list the names and data of the 15 most commonly elements.	5 most - list the names and data of the 15 most commonly occuring elements.
- the make-up of a variety of compounds.	- when given formulas for a variety of compounds, elements found in each.	compounds. - when given formulas for a variety of compounds, state the elements found in each.
- the transformation of matter.	- describe the manner in which matter may be cha one form to another without any loss or gain po	r. - describe the manner in which matter may be changed from one form to another without any loss or gain possible.
		Grade 7
General Science		ral Science
- the function of the nitrogen cycle.	- diagram and label the nitrogen cycle.	n cycle. - diagram and label the nitrogen cycle.
- the phases of mitosis.	- list the phases of mitosis .	- list the phases of mitosis .
	- explain orally the occurances in each phase.	- explain orally the occurances in each phase.
	- diagram and label the phases of mitoses.	- diagram and label the phases of mitoses.
- that the need for conservation of our resources is vital to man's survival.	- define exploitation.	don of our survival. - define exploitation.
	- describe factors leading to the exploitation o plant, and wild life, and air.	- describe factors leading to the exploitation of soil, water, plant, and wild life, and air.
	- define conservation.	- define conservation.

	- define ecology.	- define ecology.
- that there are 4 major areas of conservation.	- list the 4 major areas: water, soil, and wildl	of - list the 4 major areas: water, soil, and wildlife & forests.
	- list various reasons why there is a need for co in each of these areas - the importance of each	- list various reasons why there is a need for conservation in each of these areas - the importance of each to mankind.
- that a watershed is a natural ecological unit which should be controlled for a number of reasons	- define the following terms: runoff, watershed, erosion,	l ecological led for a - define the following terms: runoff, watershed, water table erosion.
	- describe the damage created by uncontrolled wat relation to flooding, loss of crops, loss of to using the Mississippi Valley, the largest water U.S. as a premise.	- describe the damage created by uncontrolled watersheds in relation to flooding, loss of crops, loss of top soil, etc. using the Mississippi Valley, the largest watershed in the U.S. as a premise.
	- describe various methods of controlling watersh as the use of dams and dikes.	- describe various methods of controlling watersheds, such as the use of dams and dikes.
	- be able to list and describe the following form erosion: wind, sheet, stream-bank, and gullies	- be able to list and describe the following forms of soil erosion: wind, sheet, stream-bank, and gullies and rills.
- that soil conservation goes hand in hand with sound methods of utilizing soil. (farming).	- compare farming methods of the past with those and describe changes that have been made to emp of soil conservation.	and in hand ng soil. - compare farming methods of the past with those now in use and describe changes that have been made to employ methods of soil conservation.
	- define the following terms: contour, plowing, covercrops, crop rotation, fertilizer.	- define the following terms: contour, plowing, terracing, covercrops, crop rotation, fertilizer.
- that biological control of environmental pests is often necessary to keep nature in balance with man's changing world.	- define the following terms: pest, pesticide, i fungicide.	vironmental eep nature in orld. - define the following terms: pest, pesticide, insecticide, fungicide.
- that there are several different types of chemical additives in our environments which help us control pests - some good and some bad.	- draw and describe the DDT cycle.	ent types of ironments some - draw and describe the DDT cycle.
	- give reasons why chemicals should not be added environment until we understand their full effe	- give reasons why chemicals should not be added to our environment until we understand their full effect.
- why forests make up one of our most valuable resources.	- list factors leading to the necessity of forest trees, i.e., lumber, paper, pulp, homes for and recreation.	r most - list factors leading to the necessity of forests and trees, i.e., lumber, paper, pulp, homes for animals, recreation.

- what methods of conservation are being employed to preserve timber.	- describe legislation which prohibits lumbering	n are being .
	- list methods of thinning out our forests, i.e. weak members of a species, logging only a smal of trees per acre.	
	- list various tree diseases caused by insects a are controlled.	
- the mechanism by which plants convert are form of matter to another form of matter, utilizing the sun's energy to form chemical hands.	- define the following: atom, proton, electron, neutron, molecule, com chemical hand matter, energy.	ts convert are orm of matter, to form
	- list the compounds utilized by plants in the p process.	
	- list the compounds formed in photosynthesis.	
	- write a balanced molecular equation for photos	
	- construct a relationship from the photosynthet sharing that matter was nutrilized created not in this process but simply changed its form.	
		Grade 8
- that we use physical and chemical properties in the identification of materials.	- perform the flame test which constitutes a phy of identifying metals.	mical proper- f naterials.
	- by dipping a clean platinum loop into a salt c particular mettalic ion he will observe the co flame produced. With the use of a spectroscop acteristic spectrum may be identified.	
- the simplest substances obtainable are called elements.	- decompose sugar to discover the elements found compound. By heating sugar in a test tube the breaks down into carbon and another compound w carbon is first identified before burning in ai	inable are
Page 5		

- describe legislation which prohibits lumbering in particular areas.	
- list methods of thinning out our forests, i.e., removing weak members of a species, logging only a small percentage of trees per acre.	
- list various tree diseases caused by insects and how they are controlled.	
- define the following: atom, proton, electron, neutron, molecule, compound, chemical hand matter, energy.	
- list the compounds utilized by plants in the photosynthesis process.	
- list the compounds formed in photosynthesis.	
- write a balanced molecular equation for photosynthesis.	
- construct a relationship from the photosynthetic equation sharing that matter was nutrilized created not destroyed in this process but simply changed its form.	
	Grade 8
- perform the flame test which constitutes a physical method of identifying metals.	
- by dipping a clean platinum loop into a salt containing a particular mettalic ion he will observe the color of the flame produced. With the use of a spectroscope a characteristic spectrum may be identified.	
- decompose sugar to discover the elements found in the compound. By heating sugar in a test tube the sugar breaks down into carbon and another compound water. The carbon is first identified before burning in air.	
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	- the visible gas is bubbled through limewater	- the visible gas is bubbled through limewater to identify it as the compound carbon dioxide when the limewater turns milky. The water produced by heating sugar is tested with cobalt chloride paper which changes from blue color to red color.
	- demonstrate the breakdown products of water c	- demonstrate the breakdown products of water carrying out an electrolysis experiment. The two gases, oxygen and hydrogen may be easily identified by testing with a glowing splint and a flaming splint.
- that matter exists as three forms or states solids, liquids, and gases.	- demonstrate the three forms of matter by heat	ee forms or states s. - demonstrate the three forms of matter by heating a piece of ice to change the solid water to liquid water. Continue heating the water to change the liquid water to gaseous water vapor.
- that energy is always involved when a substance changes from one state to another.	- plot a graph using temperature as a function	olved when a e state to - plot a graph using temperature as a function of time when heating the ice and water in the experiment above. By observing the plateaus at the boiling point and freezing point the energy change at the phase or change of state is discovered.
- mixtures are complex substances and not a single substance.	- seperate a solution of salt and water by heati	tances and not - seperate a solution of salt and water by heating the solution in an evaporating dish to remove the water and then to observe the residue which remains.
- matter is particulate and not continuous.	- look at newspaper clippings to discover the va	not continuous. - look at newspaper clippings to discover the various shade of grey and black using a hand lens to see the tiny individual particles which compose the pictures.
- atoms collide and stay together forming bonds which hold these atoms together as molecules.	- perform a demonstration to show how the partic	gether forming oms together - perform a demonstration to show how the particles from hydrochloric acid combine with the particles from ammonium chloride to form a solid substance ammonium chloride. He will take each of these liquids add them to seperate corks and place the corks into an open piece of large glass tubing. A white cloud of ammonium chloride forms as the two gases collide to form a white ring in the tube.

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- that extremely large numbers and extremely small numbers may be expressed by using exponentials to show their magnitude.

- that matter is made up of molecules. Molecules are made up of atoms which are the smallest structural part of matter. Atoms are distinguished by their structure which is the smallest functional part of the elements.

- the atom is made of smaller particles (the neutron, proton, electron) which are arranged in a definite pattern.

- why any two elements may or may not react together.

- list in writing the multiples and submultiples for the following expressions:

T=tera 10^{12}	M=micro 10^{-6}
G=giga 10^{9}	N=nano 10^{-9}
K=kilo 10^{3}	P=pico 10^{-10}
H=hecto 10^{2}	F=fento 10^{-15}
Da=deka 10^{1}	A=atto 10^{-18}
deci 10^{-1}	
C=centi 10^{2}	
M=milli 10^{3}	

- list the general physical properties of elements.

- distinguish between physical and chemical changes.

- distinguish between elements, compounds, and mixtures.

- identify a give sample of an element as metallic or nonmetallic.

draw a simple diagram of an atom.

- list the characteristics (size, weight, charge and location) of the 3 main particles that make up an atom.

- distinguish an atom by its atomic structure and identify it as an element.

- list elements according to atomic number.

- list the number of protons, neutrons, and electrons for each element.

- arrange electrons in orbits by the definite arrangement.

- recognize an inert element.

	- determine which elements will share electrons a stable.
- the periodic table is a functional chart of elements by atomic number, electron configuration, and chemical properties.	- identify families and periods of elements, - distinguish between metal and non-metal - list properties of families and which families which other families.
- atoms of elements combine in regular definite patterns.	- identify the components of simple molecular co - write the formula of simple compounds. - write a simple balanced equation.
- typical reactions of families of elements such as metal and nonmetal.	- identify by properties the elements which are those that are nonmetals. - write balanced equations for the reaction betw and nonmetal.
- reactions generally fall into specific catagories. A general equation can be written which would summarize all the examples in that category.	- describe composition reactions and write the g equation to show this type of reaction. - describe decomposition reactions and write the equation to show this type of reaction. - describe the neutralization reaction and write equation to show this type of reaction.
	- perform one of each type of reaction.

Introductory to Physical Science

- that when matter undergoes a physical or chemical change, mass is conerved.	- measure volume of a substance by one of variou

	- determine which elements will share electrons and become stable.
nctional chart er, electron l properties.	- identify families and periods of elements, - distinguish between metal and non-metal - list properties of families and which families react with which other families.
in regular	- identify the components of simple molecular compounds. - write the formula of simple compounds. - write a simple balanced equation.
les of elements	- identify by properties the elements which are metals and those that are nonmetals. - write balanced equations for the reaction between a metal and nonmetal.
nto specific ation can be ize all the	- describe composition reactions and write the general equation to show this type of reaction. - describe decomposition reactions and write the general equation to show this type of reaction. - describe the neutralization reaction and write the general equation to show this type of reaction.
	- perform one of each type of reaction.

Grade 9

Physical Science

a physical or nserved.	- measure volume of a substance by one of various methods.

- establish a weight scale.

- measure the mass of a substance.

- demonstrate that mass is conserved when a phas
  a solid dissolves in a liquid, a chemical reac
  a preciptate.

- a chemical reaction produces a gas.

- two solids react chemically when heated.

- that characteristic properties of a substance can be used to distinguish one substance from another.

- determine the densities of solids, liquids, an ies of a stinguish

- determine the thermal expansion of solids, liq

- determine the elasticity of solids and gas.

- determine the freezing and melting points of s

- determine the boiling point of a liquid.

- determine the solubility of substances in vari
  and at various temperatures.

- read solubility graphs.

- demonstrate that the solubility of gases decre
  increase in temperature.

- that mixtures of pure substances can be seperated on the basis of their characteristic properties.

- separate a mixture of two liquids using fracti nces can be eir character- distillation.

- seperate an insoluble solid from a soluble sol
  filtration.

- separate a mixture of two soluble solids using
  crystallization.

- separate a mixture of soluble solids using pa
  chromatography.

- establish a weight scale.

- measure the mass of a substance.

- demonstrate that mass is conserved when a phase change occurs, a solid dissolves in a liquid, a chemical reaction produces a preciptate.

- a chemical reaction produces a gas.

- two solids react chemically when heated.

- determine the densities of solids, liquids, and gases.

- determine the thermal expansion of solids, liquids, and gases

- determine the elasticity of solids and gas.

- determine the freezing and melting points of substances.

- determine the boiling point of a liquid.

- determine the solubility of substances in various solvents and at various temperatures.

- read solubility graphs.

- demonstrate that the solubility of gases decreases with increase in temperature.

- separate a mixture of two liquids using fractional distillation.

- seperate an insoluble solid from a soluble solid using filtration.

- separate a mixture of two soluble solids using fractional crystallization.

- separate a mixture of soluble solids using paper chromatography.

- that when the end products of a separated mixture are physically combined, the original substance will be formed.	- combine the end products of the fractional dist paper chromatography experiments to obtain the mixtures.	f a ally ance - combine the end products of the fractional distillation or paper chromatography experiments to obtain the original mixtures.
- that compounds can be separated by chemical means.	- decompose a compound by means of heat.	ted by - decompose a compound by means of heat.
	- decompose a compound by means of electrolysis.	- decompose a compound by means of electrolysis.
- that pure substances are classified as either elements or compounds.	- analyze elements and compounds using flame test spectral analysis.	ssified as . - analyze elements and compounds using flame tests and spectral analysis.
- that matter is made up of tiny particles called atoms.	- observe the effect of radioactive substances on film Geiger counter, and cloud chamber.	ny particles - observe the effect of radioactive substances on photographic film Geiger counter, and cloud chamber.

Grade 10

Biology		**ogy**
- how a scientist conducts an investigation and the characteristics of the system he uses to make measurements.	- differentiate between a control group and an ex group.	investigation he system he - differentiate between a control group and an experimental group.
	- differentiate between a hypothesis and a theory	- differentiate between a hypothesis and a theory.

Grade 10-11

Physical Science		**cal Science**
- that there are many forms of matter made up of various particles and differing in properties as well as in composition.	- be able to identify the various forms of matter example of each.	matter made up of ring in properties - be able to identify the various forms of matter and give an example of each.
	- catagorize the forms in terms of metals, non-me etc.	- catagorize the forms in terms of metals, non-metals, gases, etc.
- the nature of atoms and molecules which make up the various forms of matter.	- be able to draw structures of both atoms and mo list the individual particles that make up the	ules which matter. - be able to draw structures of both atoms and molecules and list the individual particles that make up the structure.
- that all matter may undergo a chemical change as well as a physical change.	- give examples of both chemical change and physi matter and identify the resulting structures.	chemical change. - give examples of both chemical change and physical change of matter and identify the resulting structures.

	- perform a simple experiment in which a chemical occurs and determine stoichiometrically how matt conserved.	- perform a simple experiment in which a chemical change occurs and determine stoichiometrically how matter is conserved.
	- be able to illustrate how it is possible to char from one form to another.	- be able to illustrate how it is possible to change matter from one form to another.
- the various phases of matter and their relation to energy.	- calculate the volume of a gas such as hydrogen w r and their will be required to form a given volume of ammor	- calculate the volume of a gas such as hydrogen which will be required to form a given volume of ammonia.
- that equal volume of gases under the same conditions of temperature and pressure contain an equal number of particles.	- be able to interpret both the Boyle Law and the under the same Law which apply to gases. nd pressure particles.	- be able to interpret both the Boyle Law and the Charles Law which apply to gases.
	- work out problems which apply to the Avagadro hy (ie; that there are 6.02×10^{23} particles in one substance.	- work out problems which apply to the Avagadro hypothesis (ie; that there are 6.02×10^{23} particles in one mole of any substance.
- that the mole concept applies to all forms of matter.	- be able to write and balance chemical equations. es to all forms	- be able to write and balance chemical equations.
	- show how the equations relate to the mole concep	- show how the equations relate to the mole concept.
	- calculate the gram atomic mass of elements and this to moles.	- calculate the gram atomic mass of elements and convert this to moles.
	- relate the situation to atomic mass and gram ato	- relate the situation to atomic mass and gram atomic mass.
- that the periodic table of the elements represents a periodic function of all the elements.	- construct the periodic table. the elements ion of all the	- construct the periodic table.
	- symbolize each element in its proper group.	- symbolize each element in its proper group.
	- organize a list of the elements so that they fa various catagories such as metals, non-metals,	- organize a list of the elements so that they fall under various catagories such as metals, non-metals, gases, etc.
	- compare the properties of each group and unders behavior from the position they occupy in the pe table.	- compare the properties of each group and understand their behavior from the position they occupy in the periodic table.
- the bonding types between atoms and their effect on structural forms.	- identify the various types of bonds. toms and their	- identify the various types of bonds.
	Page 11	Page 11

- a substance is a homogenous variety of matter all specimens of which have identical properties and composition.

- matter may exist in a solid, liquid or gaseous phase. A change in phase is accompanied by the absorption or release of energy.

- gases take the shape and volume of the container they occupy.

- liquids have a definite volume but no definite shape. They take the shape of the container they occupy.

- illustrate each type by a diagram.

- compare the physical properties of each type of

- be able to measure the ability of an element to electron.

- be able to use the electronegativity table to predict the nature of a bond.

- list general properties which can be used to id elements.

- list changes which indicate a chemical reaction

- identify by observation whether a compound or a formed when two elements are combined.

- identify and distinguish solids, liquids, and g

- read and interpret a phase change diagram.

- list values for standard temperature and pressu

- explain and calculate changes in gas volume usi Boyle's and Charle's Law.

- calculate the volume change of a gas using the gas laws.

- list the reasons the Ideal Gas Laws do not hold high pressures and low temperatures.

- list the properties of a gas under the Kinetic T Gases.

- describe the arrangement and motion of particles liquid.

- illustrate each type by a diagram.

- compare the physical properties of each type of bond.

- be able to measure the ability of an element to attract electron.

- be able to use the electronegativity table to predict the nature of a bond.

variety which have mposition.

- list general properties which can be used to identify elements.

- list changes which indicate a chemical reaction takes place.

- identify by observation whether a compound or a mixture is formed when two elements are combined.

liquid or phase is on or release

- identify and distinguish solids, liquids, and gases.

- read and interpret a phase change diagram.

- list values for standard temperature and pressure.

ume of the

- explain and calculate changes in gas volume using Boyle's and Charle's Law.

- calculate the volume change of a gas using the combined gas laws.

- list the reasons the Ideal Gas Laws do not hold true at high pressures and low temperatures.

- list the properties of a gas under the Kinetic Theory of Gases.

e but no e shape of

- describe the arrangement and motion of particles in a liquid.

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- predict the affect of pressure on a liquid.

- determine the heat of vaporization of a liquid.

- identify the boiling point of a liquid from a va pressure graph.

- solids have a definite volume and shape.

- describe position and arrangement of particles i basic geometric solids.

- define the melting point and determine its valu various solids.

- read and interpert a cooling curve on a graph.

- calculate the heat of fusion of various solids.

- that energy may be converted from one form to another but is never destroyed, in a chemical reaction energy is either absorbed or released.

- list examples of the different forms of energy.

- differentiate between exothermic and endothermi

- apply the law of conservation of matter and ene chemical equations.

- measure the change in the energy content of a c reaction.

- conver from Celsius to Kelvin temperature scale

- that scientific experiments apparently support the particulate nature of matter: that all elements are composed of basic chemical units-atoms. The atoms themselves are structured.

- describe the fundamental properties of the elec proton, and neutron.

- relate the mass number and atomic number to the of each atom.

- list differences among the isotooes of a partic

- write the symbol for the more common elements w atomic number and mass number.

- predict the affect of pressure on a liquid.

- determine the heat of vaporization of a liquid.

- identify the boiling point of a liquid from a vapor pressure graph.

- describe position and arrangement of particles in the basic geometric solids.

- define the melting point and determine its value for various solids.

- read and interpert a cooling curve on a graph.

- calculate the heat of fusion of various solids.

- list examples of the different forms of energy.

- differentiate between exothermic and endothermic reactions.

- apply the law of conservation of matter and energy to chemical equations.

- measure the change in the energy content of a chemical reaction.

- conver from Celsius to Kelvin temperature scale.

- describe the fundamental properties of the electron, proton, and neutron.

- relate the mass number and atomic number to the structure of each atom.

- list differences among the isotooes of a particular element.

- write the symbol for the more common elements with its atomic number and mass number.

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- that modern concepts of atomic structure have evolved and continue to evolve as new experimental information is presented.

- discuss the relationship between the energy lev... Bohr model and the observed spectrum of hydroge...

- list the four quantum numbers and describe prop... the energy levels that they convey.

- write the electron configuration notation for t... with atomic numbers 1-20.

- draw the orbital notation for the elements with... numbers 1-20.

- reproduce an electron-dot diagram for any given...

- explain how the properties and electronic struc... atoms are related to the ionization energies, e... affinities, and electronegativities.

- observe and discuss the difference in the line ... several elements.

- that the source of radioactivity and atomic energy is the nucleus of the atom.

- distinguish between alpha, beta, and gamma radi...

- write balanced equations to show the radioactive...

- perform simple calculations based on the half-li... radioisotope.

- use a geiger counter or a cloud chamber to detec... radiation.

- a chemical bond results from the simultaneous attraction of electrons to two nuclei.

- relate energy changes to exothermic and endother... reactions.

- predict the stability of a compound from heat of...

- chemical changes will occur among atoms if the changes lead to a lower energy condition and hence a more stable structure.

- predict the tendency of an element to react base... ionization energy.

- discuss the relationship between the energy levels in the Bohr model and the observed spectrum of hydrogen.

- list the four quantum numbers and describe properties of the energy levels that they convey.

- write the electron configuration notation for the elements with atomic numbers 1-20.

- draw the orbital notation for the elements with atomic numbers 1-20.

- reproduce an electron-dot diagram for any given element.

- explain how the properties and electronic structure of atoms are related to the ionization energies, electron affinities, and electronegativities.

- observe and discuss the difference in the line spectra of several elements.

- distinguish between alpha, beta, and gamma radiation.

- write balanced equations to show the radioactive processes.

- perform simple calculations based on the half-life of a radioisotope.

- use a geiger counter or a cloud chamber to detect radiation.

- relate energy changes to exothermic and endothermic reactions.

- predict the stability of a compound from heat of formation.

- predict the tendency of an element to react based on its ionization energy.

	- predict the tendency of an element to react bas electron affinity.	- predict the tendency of an element to react based on its electron affinity.
- the electrons involved in bond formation many be transferred from one atom to another, or may be shared equally or unequally between two atoms.	- describe and explain the tendency of an atom to their maximum complement of valence electrons.	nd formation atom to ually or - describe and explain the tendency of an atom to obtain their maximum complement of valence electrons.
	- distinguish between ionic, covalent, and metall and characteristics of each type of bond.	- distinguish between ionic, covalent, and metallic bonding and characteristics of each type of bond.
	- differentiate electronic configuration of an at ion and make drawings of each.	- differentiate electronic configuration of an atom from its ion and make drawings of each.
	- draw and interpert electron dot diagrams.	- draw and interpert electron dot diagrams.
	- use electronegitivity difference to determine t character of a bond.	- use electronegitivity difference to determine the ionic character of a bond.
	- distinguish between polar and nonpolar substanc	- distinguish between polar and nonpolar substances.
- groups of atoms covalently bonded in a molecule may be attracted to similar molecules or to ions.	- recognize and explain the distribution of charg gives rise to a dipole unit.	onded in a similar - recognize and explain the distribution of charge which gives rise to a dipole unit.
	- explain the nature of the hydrogen bond.	- explain the nature of the hydrogen bond.
	- describe and explain van der waal's forces.	- describe and explain van der waal's forces.
	- relate van der wall's forces to increasing boil of a series of similar compounds.	- relate van der wall's forces to increasing boiling points of a series of similar compounds.
	- explain the solubility of compounds in polar or solvents.	- explain the solubility of compounds in polar or nonpolar solvents.
- a chemical formula is both a qualitative and a quantitative expression of the composition of an element or a compound.	- recognize and write symbols for the elements.	qualitative of the compound. - recognize and write symbols for the elements.
	- distinguish and write molecular and empirical f	- distinguish and write molecular and empirical formulas.
	- use traditional nomenclature to name acides, ba salts.	- use traditional nomenclature to name acides, bases, and salts.
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- that the periodic table has progressed through many different stages. However, the periodic table today is based on atomic number and properties.

- that the periodic table can be used as a means of determining the properties and characteristics of elements.

- that the column is a relationship among the elements of a given group (family)

- list oxidation numbers for elements.

- write and balance a simple equation.

- name and explain the basis of the three forerun modern periodic table.

- diagram and explain the reasons for the present of the elements in the periodic table.

- identify groups and series on the periodic tabl

- explain the trends within a given period or gro

- graph the atomic radii of elements verses atomi

- approximate the ionic radius of an element from in the periodic table.

- identify the positions of metals, nonmetals, an on the periodic table.

- graph the ionization energy verses atomic numbe

- graph the electron affinity verses atomic numbe

- list the general characteristics of metals, non metalloids.

- determine the number of valence electrons commo in a given group.

- list the general properties and characteristics group, more specifically one of the "A" groups tative elements).

- list and explain the properties of a group of t elements.

- list oxidation numbers for elements.

- write and balance a simple equation.

- name and explain the basis of the three forerunners of the modern periodic table.

- diagram and explain the reasons for the present arrangement of the elements in the periodic table.

- identify groups and series on the periodic table.

- explain the trends within a given period or group.

- graph the atomic radii of elements verses atomic numbers.

- approximate the ionic radius of an element from its position in the periodic table.

- identify the positions of metals, nonmetals, and metalloids on the periodic table.

- graph the ionization energy verses atomic number.

- graph the electron affinity verses atomic number.

- list the general characteristics of metals, nonmetals, and metalloids.

- determine the number of valence electrons common to elements in a given group.

- list the general properties and characteristics of a given group, more specifically one of the "A" groups (representative elements).

- list and explain the properties of a group of transition elements.

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	- list and explain the properties of the Group 0 e	- list and explain the properties of the Group 0 elements.
- as a period is observed from left to right, a study of the elements leads to certain generalizations pertaining to size, ionization energies, oxidation states, valence and metallic characteristics.	- list and explain the trends within a given perio of the following: - radii, - ionization energies, - electronegativities, - oxidation states, - valence electrons (dot formulas), - metallic characteristics.	- list and explain the trends within a given period of each of the following: - radii, - ionization energies, - electronegativities, - oxidation states, - valence electrons (dot formulas), - metallic characteristics.
- that there are two (2) special series of transition elements.	- list and describe the two special series of e giving the following: - atomic numbers of elements in each, - how they differ from other transitions element - importance of series.	- list and describe the two special series of elements giving the following: - atomic numbers of elements in each, - how they differ from other transitions elements. - importance of series.
	- identify the major energy level in which electr filling in for the particular transition series	- identify the major energy level in which electrons are filling in for the particular transition series.
	- list the variable possible valances that a part transition element may have.	- list the variable possible valances that a particular transition element may have.
- that the rate of a chemical reaction depends upon many factors as well as the change in the energy of the system.	- determine the rate of a chemical reaction.	- determine the rate of a chemical reaction.
	- calculate the heat of reaction for a chemical r	- calculate the heat of reaction for a chemical reaction.
	- predict the affect on the rate of a chemical re a change in concentration takes place.	- predict the affect on the rate of a chemical reaction when a change in concentration takes place.
	- predict the affect on the rate of a chemical re when a change in temperature takes place.	- predict the affect on the rate of a chemical reaction when a change in temperature takes place.
	- predict the affect on the rate of a chemical re when a catalyst is added.	- predict the affect on the rate of a chemical reaction when a catalyst is added.
	- predict the affect on the rate of a chemical re the reaction mechanism is know.	- predict the affect on the rate of a chemical reaction when the reaction mechanism is know.

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- that the rates of change of some chemical reactions are equal in the opposite directions and these rates can be changed by various factors.	- list the different types of equilibrium systems	- list the different types of equilibrium systems.
	- apply Le Chatelier's principle with respect to	- apply Le Chatelier's principle with respect to the different equilibrium systems.
	- predict the change in rates with a change in c	- predict the change in rates with a change in concentration.
	- predict the change in the rate with a change i	- predict the change in the rate with a change in temperature.
	- predict the change in the rate with a change i	- predict the change in the rate with a change in pressure.
	- predict the change in the rate with the additi catalyst.	- predict the change in the rate with the addition of a catalyst.
	- formulate the equilibrium expression from the equation.	- formulate the equilibrium expression from the chemical equation.
	- predict the strength of an acid or base from t of the equilibrium constant.	- predict the strength of an acid or base from the magnitude of the equilibrium constant.
	- predict the solubility of a substance by the m the solubility product constant.	- predict the solubility of a substance by the magnitude of the solubility product constant.
- that chemical reactions take place spontaneously when there is an energy loss and entropy gain in the chemical system.	- determine the energy change within a given che - determine the entropy change within a given ch reaction.	- determine the energy change within a given chemical reaction. - determine the entropy change within a given chemical reaction.
	- predict if a chemical reaction takes place spo from the value of the free energy of the chemi	- predict if a chemical reaction takes place spontaneously from the value of the free energy of the chemical reaction.
	- predict the stability of a compound from its h formation.	- predict the stability of a compound from its heat of formation.
- that an electrolyte is a solution composed of ions.	- list specific examples of electrolytes: ionic and acids.	- list specific examples of electrolytes: ionic compounds and acids.
	- state the factors which affect boiling and fre	- state the factors which affect boiling and freezing points.

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- that solutions may be classified as acids or bases. Each having their own characteristic properties.	- list the characteristic properties of acids.	sified as acids ir own character- - list the characteristic properties of acids.
	- state the Arrhenius and Bronsted-Lowry definitio acids, and use a reaction to show each.	- state the Arrhenius and Bronsted-Lowry definitions of acids, and use a reaction to show each.
	- list the characteristic properties of bases.	- list the characteristic properties of bases.
	- use the Arrhenius and Bronsted-Lowry theories to examples of a base.	- use the Arrhenius and Bronsted-Lowry theories to give examples of a base.
	- define and give an example of an amphoteric subs the help of chart-H on the periodic table-handou	- define and give an example of an amphoteric substance with the help of chart-H on the periodic table-handout.
- acid-base neutralization pertains to the reaction which occurs when equivalent quantities of an acid and a hydroxide are mixed.	- determine the concentration of an acid or base, the titration method and the titration formula, the concentration of an acid.	ertains to the equivalent a hydroxide - determine the concentration of an acid or base. Using the titration method and the titration formula, determine the concentration of an acid.
	- predict the salt formed from an acid-base reacti	- predict the salt formed from an acid-base reaction.
	- determine acids, bases, conjugate acids and conj in a given reaction.	- determine acids, bases, conjugate acids and conjugate bases in a given reaction.
	- define and give an example of a buffer.	- define and give an example of a buffer.
- that the degree of ionization of an acid will determine the concentration of the solution.	- determine the strongest acid and the weakest aci list containing their ionization constant.	ion of an acid ration of the - determine the strongest acid and the weakest acid from a list containing their ionization constant.
	- calculate the hydronium ion concentration of a using the ionization constant of water.	- calculate the hydronium ion concentration of a solution using the ionization constant of water.
	- calculate the PH and the POH of a solution.	- calculate the PH and the POH of a solution.
	- calculate the hydronium ion concentration from p	- calculate the hydronium ion concentration from ph.
	- write the expression used to find ph.	- write the expression used to find ph.
	- determine the ph of a solution by using hydrion	- determine the ph of a solution by using hydrion paper.
	- solve molarity problems.	- solve molarity problems.

- that the oxidation-reduction reactions result from the competition between atoms for electrons.	- determine the oxidation numbers of the atoms of in a compound by applying the rules of assigni numbers.	- determine the oxidation numbers of the atoms of elements in a compound by applying the rules of assigning oxidation numbers.
	- identify the element which undergoes the proces oxidation by the change in the oxidation state.	- identify the element which undergoes the process of oxidation by the change in the oxidation state.
	- identify the element which undergoes the proces reduction by the change in the oxidation state.	- identify the element which undergoes the process of reduction by the change in the oxidation state.
	- determine the number of electrons lost by the r and the number of electrons gained by the oxidi	- determine the number of electrons lost by the reducing agent and the number of electrons gained by the oxidizing agent.
- that the proper arrangement of an oxidizing agent and a reducing agent can result in the production of electricity by a chemical reaction,	- identify a half-cell reaction which involves ox	- identify a half-cell reaction which involves oxidation.
	- identify a half-cell reaction which involves re	- identify a half-cell reaction which involves reduction.
	- determine the total cell potential from the cou two half-cells.	- determine the total cell potential from the coupling of two half-cells.
	- determine if the oxidation-reduction reaction spontaneous by the sign of the cell potential.	- determine if the oxidation-reduction reaction will be spontaneous by the sign of the cell potential.
	- determine under what conditions an electrochemi will have a total potential of zero.	- determine under what conditions an electrochemical cell will have a total potential of zero.
- that in an electrolytic cell oxidation and reduction reactions can be forced to take place by supplying electrical energy from an external source,	- determine the oxidation reaction which takes pl positive electrode in a given electrolytic cell	- determine the oxidation reaction which takes place at the positive electrode in a given electrolytic cell.
	- determine the reduction reaction which takes pl negative electrode in a given electrolytic cell	- determine the reduction reaction which takes place at the negative electrode in a given electrolytic cell.
	- draw a diagram to show the operation of a parti electrolytic cell.	- draw a diagram to show the operation of a particular electrolytic cell.
- that the balancing of difficult equations can be done more easily by using the oxidation and reduction method to balance.	- write the oxidation equation.	- write the oxidation equation.
	- write the reduction equation.	- write the reduction equation.

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	- balance the oxidation equation and the reductio equation so that the number of electrons lost e the number of electrons gained,	- balance the oxidation equation and the reduction equation so that the number of electrons lost equal the number of electrons gained,
	- balance the general equation by using coefficie attained from the balancing of the oxidation eq and the reduction equation,	- balance the general equation by using coefficients attained from the balancing of the oxidation equation and the reduction equation,
- that the large number of organic compounds results from the unique ability of carbon to form stable bonds with itself as well as with other elements,	- recognize the difference between an organic and inorganic compound,	ganic compounds lity of carbon itself as well as - recognize the difference between an organic and an inorganic compound,
	- draw the carbon tetrahedron,	- draw the carbon tetrahedron,
	- list the general properties of organic compound contrast them with those of inorganic compounds	- list the general properties of organic compounds and contrast them with those of inorganic compounds,
	- distinguish between saturated and unsaturated m	- distinguish between saturated and unsaturated mol ecules,
- that the large number and diversity of carbon compounds necessitates a logical system of classification and nomenclature,	- recognize the different classes of carbon compo upon structural differences,	iversity of carbon gical system of ture, - recognize the different classes of carbon compounds based upon structural differences,
	- name and write formulas for the simple hydrocar	- name and write formulas for the simple hydrocarbon compounds
	- make ball-and-stick models of the simple hydroc compounds,	- make ball-and-stick models of the simple hydrocarbon compounds,
	- draw the structure of a given member of a homol of hydrocarbons,	- draw the structure of a given member of a homologous series of hydrocarbons,
	- discuss the sources and uses of some important	- discuss the sources and uses of some important hydrocarbons,
- that a large number of derivatives are possible by modifying hydrocarbon molecules,	- write structures for and name some of the more organic derivates in the following classes: - halides - esters - alcohols - ketones - aldehydes - acids - amines - ethers	vatives are carbon molecules, - write structures for and name some of the more common organic derivates in the following classes: - halides - esters - alcohols - ketones - aldehydes - acids - amines - ethers
	Page 21	Page 21

- that many organic compounds can be formed by a few common reactions.

- investigate experimentally some simple addition
substitution reactions.

- prepare some simple esters from acids and alcoh

- prepare a complex organic compound and check it
by determing its melting point.

- observe (or preform) the polymerization of a pl

- observe a fermentation reaction.

- seperate a mixture of organic liquids by distil

- write correctly balanced equations for simple o
reactions.

- identify the products and explain their uses fr
following reactions:

  - fermentation
  - substitution
  - saponification
  - esterification
  - polimerization
  - addition

- the relationship of chemistry and physics to the study of living things.

- diagram the atomic structure of the elements us
Bohr Model of the atom.

- compare and contrast covalent, ionic, and dydro

- describe free energy change and entropy.

- compare and contrast carbohydrates, lipids, and

- recognize the functional groups: methylk, hydr
carboxyl, carbonyl-keto and aldo, suffhydryl, a

ds can be formed

- investigate experimentally some simple addition and substitution reactions.

- prepare some simple esters from acids and alcohols.

- prepare a complex organic compound and check its purity by determing its melting point.

- observe (or preform) the polymerization of a plastic.

- observe a fermentation reaction.

- seperate a mixture of organic liquids by distillation.

- write correctly balanced equations for simple organic reactions.

- identify the products and explain their uses from the following reactions:

  - fermentation
  - substitution
  - saponification
  - esterification
  - polimerization
  - addition

stry and
living things.

- diagram the atomic structure of the elements using the Bohr Model of the atom.

- compare and contrast covalent, ionic, and dydrogen bonds.

- describe free energy change and entropy.

- compare and contrast carbohydrates, lipids, and proteins.

- recognize the functional groups: methylk, hydroxyl, carboxyl, carbonyl-keto and aldo, suffhydryl, amino, etc.

- identify the molecular structure of carbohydrat
acids, lipids, amino acids, nucleotides, porphy

- identify the 2 dimensional and 3 dimensional st
proteins and the double helix model.

- compute problems showing knowledge of concepts
stoichiometry and chemical equilibria,

- the role of enzymes in nature.

- de'inecatalysts and catalysis.

- describe the enzyme - substrate complex and ho
work.

- compare and contrast competitive and noncompeti
inhibitors.

- list the factors affecting the rate and/or dir
of enzyme reactions.

- compare and contrast enzymes and coenzymes.

- describe the enzyme "lock & key" hypothesis.

- define and give examples of inorganic cofactor
prosthetic groups.

- identify the molecular structure of carbohydrates organic
acids, lipids, amino acids, nucleotides, porphyrins.

- identify the 2 dimensional and 3 dimensional structure of
proteins and the double helix model.

- compute problems showing knowledge of concepts of
stoichiometry and chemical equilibria,

re.

- de'inecatalysts and catalysis,

- describe the enzyme - substrate complex and how enzymes
work.

- compare and contrast competitive and noncompetitive
inhibitors,

- list the factors affecting the rate and/or direction
of enzyme reactions.

- compare and contrast enzymes and coenzymes.

- describe the enzyme "lock & key" hypothesis.

- define and give examples of inorganic cofactors, and
prosthetic groups.

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