



SCIENCE SKILLS

The learner will

- ☑ explain how science and technology are related.
- ☑ list the major branches of natural science and describe how they overlap.
- ☑ describe the main ideas of physical science.
- ☑ describe the steps in a scientific method.
- ☑ compare and contrast facts, scientific theories and scientific laws.
- ☑ explain the importance of models in science.
- ☑ explain the importance of safety in science.
- ☑ perform calculations involving scientific notation and conversion factors.
- ☑ identify the metric and SI units used in science and convert between common metric prefixes.
- ☑ compare and contrast accuracy and precision.
- ☑ relate the Celsius, Kelvin and Fahrenheit scales.
- ☑ organize and analyze data using tables and graphs.
- ☑ identify the relationship between a manipulated variable and a responding variable.
- ☑ explain the importance of communicating data.
- ☑ discuss the process of peer review.

PROPERTIES OF MATTER

The learner will

- ☑ classify pure substances as elements or compounds.
- ☑ describe the characteristics of an element and the symbols used to identify elements.
- ☑ describe the characteristics of a compound.
- ☑ distinguish pure substances from mixtures.
- ☑ classify mixtures as heterogeneous or homogenous.
- ☑ classify mixtures as solutions, suspensions, or colloids.
- ☑ describe physical properties of matter.
- ☑ identify substances based on their physical properties.
- ☑ describe how properties are used to choose materials.
- ☑ describe methods used to separate mixtures.
- ☑ describe evidence that indicates a physical change is taking place.

STATES OF MATTER

The learner will

- ☑ describe chemical properties of matter.
- ☑ describe clues that indicate that a chemical change is taking place.
- ☑ distinguish chemical changes from physical changes.
- ☑ describe the five states of matter.
- ☑ classify materials as solids, liquids or gases.
- ☑ explain the behavior of gases, liquids and solids using kinetic theory.
- ☑ define pressure and gas pressure.
- ☑ identify factors that affect gas pressure.
- ☑ predict changes in gas pressure due to changes in temperature, volume and number of particles.
- ☑ explain Charles' law, Boyle's law and the combined gas law.
- ☑ apply gas laws to solve problems involving gases.
- ☑ describe phase changes.
- ☑ explain how temperature can be used recognize a phase change.
- ☑ explain what happens to the motion, arrangement and average kinetic energy of water molecules during phase changes.
- ☑ describe each of the six phase changes.
- ☑ identify phase changes as endothermic or exothermic.



ATOMIC STRUCTURE

The learner will

- describe ancient Greek models of matter.
- list the main points of Dalton's atomic theory and describe his evidence for the existence of atoms.
- explain how Thomson and Rutherford used data from experiments to produce their atomic models.
- identify three subatomic particles and compare their properties.
- distinguish the atomic number of an element from the mass number of an isotope and use these numbers to describe the structure of atoms.
- describe Bohr's model of the atom and the evidence for energy levels.
- explain how the electron cloud model represents the behavior and locations of electrons in atoms.
- distinguish the ground state from excited states of an atom based on electron configurations.

THE PERIODIC TABLE

The learner will

- describe how Mendeleev arranged the elements in his table.
- explain how the predictions Mendeleev made and the discovery of new elements demonstrated the usefulness of his periodic table.
- describe the arrangement of elements in the modern periodic table.
- explain how the atomic mass of an element is determined and how atomic mass units are defined.
- identify general properties of metals, nonmetals and metalloids.
- describe how properties of elements change across a period in the periodic table.
- relate the number of valence electrons to groups in the periodic table and to properties of elements in those groups.
- predict the reactivity of some elements based on their locations within a group.
- identify some properties of common A group elements.

CHEMICAL BONDS

The learner will

- recognize stable electron configurations.
- predict an element's chemical properties using number of valence electrons and electron dot diagrams.
- describe how an ionic bond forms and how ionization energy affects the process.
- predict the composition of an ionic compound from its chemical formula.
- relate the properties of ionic compounds to the structure of crystal lattices.
- describe how covalent bonds form and the attractions that keep atoms together in molecules.
- compare polar and non-polar bonds and demonstrate how polar bonds affect the polarity of a molecule.
- compare the attractions between polar and non-polar molecules.
- recognize and describe binary ionic compounds, metals with multiple ions and polyatomic ions.
- name and determine chemical formulas for ionic and molecular compounds.
- describe the structure and strength of bonds in metals.
- relate the properties of metals to their structure.
- define an alloy and demonstrate how the composition of an alloy affects its properties.

CHEMICAL REACTIONS

The learner will

- interpret chemical equations in terms of reactants, products and conservation of mass.
- balance chemical equations by manipulating coefficients.
- convert between moles and mass of a substance using molar mass.
- calculate amounts of reactants or products by using molar mass, mole ratios and balanced chemical equations.
- classify chemical reactions as synthesis, decomposition, single-replacement, double-replacement or combustion reactions.
- describe oxidation-reduction reactions and relate them to other classifications of chemical reactions.
- describe the energy changes that take place during chemical reactions.



CHEMICAL REACTIONS

The learner will

- ☑ classify chemical reactions as exothermic or endothermic.
- ☑ explain how energy is conserved during chemical reactions.
- ☑ explain what a reaction rate is.
- ☑ describe the factors affecting chemical reaction rates.
- ☑ identify and describe physical and chemical equilibria.
- ☑ describe the factors affecting chemical equilibrium.
- ☑ describe how a substance can dissolve in water by dissociation, dispersion or ionization.
- ☑ describe how the physical properties of a solution can differ from those of its solute and solvent.
- ☑ identify energy changes that occur during the formation of a solution.
- ☑ describe factors affecting the rate at which a solute dissolves into a solvent.
- ☑ define solubility and describe factors affecting solubility.
- ☑ classify solutions as unsaturated, saturated and supersaturated.
- ☑ calculate and compare and contrast solution concentrations expressed as percent by volume, percent by mass and molarity.

SOLUTIONS, ACIDS AND BASES

The learner will

- ☑ define acid and describe some of the general properties of an acid.
- ☑ define base and describe some of the general properties of a base.
- ☑ identify a neutralization reaction and describe the reactants and products of neutralization.
- ☑ explain how acids and bases can be defined as proton donors and proton acceptors.
- ☑ define pH and relate pH to hydronium ion concentration in a solution.
- ☑ distinguish between strong acids and weak acids and between strong bases and weak bases.
- ☑ define buffer and describe how a buffer can be prepared.
- ☑ explain how electrolytes can be classified.

MOTION

The learner will

- ☑ identify frames of reference and describe how they are used to measure motion.
- ☑ identify appropriate SI units for measuring distances.
- ☑ distinguish between distance and displacement.
- ☑ calculate displacement using vector addition.
- ☑ identify appropriate SI units for measuring speed.
- ☑ compare and contrast average speed and instantaneous speed.
- ☑ interpret distance-time graphs.
- ☑ calculate the speed of an object using slopes.
- ☑ describe how velocities combine.

FORCES AND MOTION

The learner will

- ☑ identify changes in motion that produce acceleration.
- ☑ describe examples of constant acceleration.
- ☑ calculate the acceleration of an object.
- ☑ interpret speed-time and distance-time graphs.
- ☑ classify acceleration as positive or negative.
- ☑ describe instantaneous acceleration.
- ☑ describe examples of force and identify appropriate SI units to measure force.
- ☑ explain how the motion of an object is affected when balanced and unbalanced forces act on it.
- ☑ compare and contrast the four kinds of friction.
- ☑ describe how earth's gravity and air resistance affect falling objects.
- ☑ describe the path of a projectile and identify the forces that produce projectile motion.



FORCES AND MOTION

The learner will

- ☑ describe Newton's first law of motion and its relation to inertia.
- ☑ describe Newton's second law of motion and use it to calculate acceleration, force and mass values.
- ☑ relate the mass of an object to its weight.
- ☑ explain how action and reaction forces are related according to Newton's third law of motion.
- ☑ calculate the momentum of an object and describe what happens when momentum is conserved during a collision.
- ☑ identify the forms of electromagnetic force that can both attract and repel.
- ☑ identify and describe the universal forces acting within the nucleus.
- ☑ define Newton's law of universal gravitation and describe the factors affecting gravitational force.
- ☑ describe centripetal force and the type of motion it produces.

FORCES IN FLUIDS

The learner will

- ☑ describe and calculate pressure.
- ☑ identify appropriate SI units for measuring pressure.
- ☑ describe the relationship between water depth and the pressure it exerts.
- ☑ describe how forces from pressure are distributed at a given level in a fluid.
- ☑ explain how altitude affects air pressure.
- ☑ describe how pressure is transmitted in a fluid according to Pascal's principle.
- ☑ explain how a hydraulic system works to change a force.
- ☑ explain how the speed and pressure of a fluid are related according to Pascal's principle.
- ☑ explain the effect of buoyancy on the apparent weight of an object.
- ☑ explain the relationship between the volume of fluid displaced by an object and buoyant force acting on the object according to Archimedes' principle.
- ☑ describe the relationship among object density, fluid density and whether an object sinks or floats in a fluid.
- ☑ describe the relationship among object weight, buoyant force, buoyant force and whether an object sinks or floats in a fluid.

WORK, POWER AND MACHINES

The learner will

- ☑ describe the conditions that must exist for a force to do work on an object.
- ☑ calculate the work done on an object.
- ☑ describe and calculate power.
- ☑ compare the units of watts and horsepower as they relate to power.
- ☑ describe what a machine is and how it makes work easier.
- ☑ relate the work input to a machine to the work output of the machine.
- ☑ compare a machine's actual mechanical advantage to its idea mechanical advantage.
- ☑ calculate the ideal and actual mechanical advantages of various machines.
- ☑ explain why the efficiency of a machine is always less than 100%.
- ☑ calculate a machine's efficiency.
- ☑ name, describe and give an example of each of the six types of simple machines.
- ☑ describe how to determine the ideal mechanical advantage of each type of simple machine.
- ☑ define and identify compound machines.



ENERGY

The learner will

- ☑ describe the relationship between work and energy.
- ☑ relate kinetic energy to mass and speed and calculate these quantities.
- ☑ analyze how potential energy is related to an object's position and give examples of gravitational and elastic potential energy.
- ☑ solve equations that relate an object's gravitational potential energy to its mass and height.
- ☑ give examples of the major forms of energy and explain how each is produced.

THERMAL ENERGY AND HEAT

The learner will

- ☑ describe conversions of energy form one form to another.
- ☑ state and apply the law of conservation of energy.
- ☑ analyze how energy is conserved in conversions between kinetic energy and potential energy and solve equations that equate initial energy to final energy.
- ☑ describe the relationship between energy and mass and calculate how much energy is equivalent to a given mass.
- ☑ classify energy resources as renewable or nonrenewable.
- ☑ evaluate benefits and drawbacks of different energy sources.
- ☑ describe ways to conserve energy resources.
- ☑ explain how heat and work transfer energy.
- ☑ relate thermal energy to the motion of particles that make up a material.
- ☑ relate temperature to thermal energy and to thermal expansion.
- ☑ calculate thermal energy, temperature change or mass using the specific heat equation.
- ☑ describe how a calorimeter operates and calculate thermal energy changes or specific heat using calorimetry measurements.
- ☑ describe conduction, convection and radiation and identify which of these is occurring in a specific situation.
- ☑ classify materials as thermal conductors or thermal insulators.
- ☑ apply the law of conservation of energy to conversions between thermal energy and other forms of energy.
- ☑ apply the second law of thermodynamics in situations where thermal energy moves from cooler to warmer objects.
- ☑ state the third law of thermodynamics.
- ☑ describe heat engines and explain how heat engines convert thermal energy into mechanical energy.
- ☑ describe how the different types of heating systems operate.
- ☑ describe how cooling systems, such as refrigerators and air conditioners, operate.
- ☑ evaluate benefits and drawbacks of different heating and cooling systems.

MECHANICAL WAVES AND SOUND

The learner will

- ☑ define mechanical waves and relate waves to energy.
- ☑ describe transverse, longitudinal and surface waves and discuss how they are produced.
- ☑ identify examples of transverse and longitudinal waves.
- ☑ analyze the motion of a medium as each kind of mechanical wave passes through it.
- ☑ define frequency, period, wavelength and wave speed and describe these properties for different kinds of waves.
- ☑ solve equations relating wave speed to wavelength and frequency to period.
- ☑ describe how to measure amplitude and relate amplitude to the energy of a wave.
- ☑ describe how reflection, refraction, diffraction and interface affect waves.
- ☑ state a rule that explains refraction of a wave as it passes from one medium to another.
- ☑ identify factors that affect the amount of refraction, diffraction or interface.
- ☑ distinguish between constructive and destructive interface and explain how standing waves form.
- ☑ describe the properties of sound waves and explain how sound is produced and reproduced.
- ☑ describe how sound waves behave in applications such as ultrasound and music.
- ☑ explain how relative motion determines the frequency of sound an observer hears.
- ☑ analyze the functions of the main regions of the human ear.



MECHANICAL WAVES AND SOUND

The learner will

- ☑ describe the characteristics of electromagnetic waves in a vacuum and how Michelson measured the speed of light.
- ☑ calculate the wavelength and frequency of an electromagnetic wave given its speed.
- ☑ describe the evidence for the dual nature of electromagnetic radiation.
- ☑ describe how the intensity of light changes with distance from a light source.

THE ELECTROMAGNETIC SPECTRUM AND LIGHT

The learner will

- ☑ rank and classify electromagnetic waves based on their frequencies and wavelengths.
- ☑ describe the uses for different waves of the electromagnetic spectrum.
- ☑ classify materials as transparent, translucent or opaque to visible light.
- ☑ describe what happens when light is reflected, refracted, polarized or scattered.
- ☑ explain how a prism disperses white light into different colors.
- ☑ analyze factors that determine the color of an object.
- ☑ distinguish among primary, secondary and complementary colors of light and of pigments.
- ☑ explain how light is produced by common sources of light.
- ☑ describe the uses of different light sources.
- ☑ distinguish lasers from other light sources.

OPTICS

The learner will

- ☑ describe the law of reflection.
- ☑ describe how a plane mirror produces an image.
- ☑ describe real and virtual images and relate them to converging and diverging light rays.
- ☑ describe the physical characteristics of plane, concave and convex mirrors and distinguish between the types of images they form.
- ☑ explain what causes light to refract.
- ☑ define index of refraction.
- ☑ describe the physical characteristics of concave and convex lenses and distinguish between the types of images they form.
- ☑ describe total internal reflection and explain its relationship to the critical angle.
- ☑ distinguish between how reflecting and refracting telescopes form images.
- ☑ explain how cameras regulate and focus light to form images.
- ☑ describe how light travels in a compound microscope to produce an enlarged image.
- ☑ name the main parts of the eye and describe their functions.
- ☑ name common vision problems, identify their causes and explain how they can be corrected.

ELECTRICITY

The learner will

- ☑ analyze the factors that affect the strength and direction of electric forces and fields.
- ☑ describe how electric forces and fields affect electric charges.
- ☑ describe how electric charges are transferred and explain why electric discharges occur.
- ☑ describe electric current and identify the two type of current.
- ☑ describe conduction and classify materials as good electrical conductors or good electrical insulators.
- ☑ describe the factors that affect resistance.
- ☑ explain how voltage produces electric current.
- ☑ calculate voltage, current and resistance using Ohm's law.
- ☑ analyze circuit diagrams for series circuits and parallel circuits.
- ☑ solve equations that relate electric power to current, voltage and electrical energy.
- ☑ describe devices and procedures for maintaining electrical safety.



ELECTRICITY

The learner will

- ☑ explain how electronics conveys information with analog or digital signals.
- ☑ describe electronic devices used to control electron flow.
- ☑ illustrate how semiconductors are used to make three kinds of solid-state components.
- ☑ describe how solid-state components are used in electronic devices.

MAGNETISM

The learner will

- ☑ describe the effects of magnetic forces and magnetic fields and explain how magnetic poles determine the direction of magnetic force.
- ☑ interpret diagrams of magnetic field lines around one or more bar magnets.
- ☑ describe Earth's magnetic field and its effect on compasses.
- ☑ explain the behavior of ferromagnetic materials in terms of magnetic domains.
- ☑ describe how a moving electric charge creates a magnetic field and determine the direction of the magnetic field based on the type of charge and the direction of its motion.
- ☑ relate the force a magnetic field exerts on a moving electric charge to the type of charge and the direction of its motion.
- ☑ explain how solenoids and electromagnets are constructed and describe factors that affect the field strength of both.
- ☑ describe how electromagnetic devices use the interaction between electric currents and magnetic fields.
- ☑ understand Electrical Energy Generation and Transmission.
- ☑ describe how electric current is generated by electromagnetic induction.
- ☑ compare AC and DC generators and explain how they work.
- ☑ analyze factors that determine the output voltage and current produced by a transformer.
- ☑ summarize how electrical energy is produced, transmitted and converted for use in the home.

RESOURCES

Prentice-Hall Physical Science: Concepts in Action (2004 Ed.)

Internet research, applications, modeling and supplementary materials.