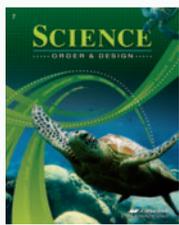


Science: Order & Design Grade 7



Many life science textbooks study the “simple” cell as the origin of life and discuss the “evolution” of life through the plant and animal worlds. *Science: Order & Design* uses a different approach.

This life science text begins with the more complex plant world and human anatomy and physiology. Evolutionary hypotheses are discussed and discarded as unscientific. Similarities between man and animals are explored and proved to be the result of a common Designer, laying a biblical foundation of origins.

A look at the complexity of the “simple” cell, the basis of all life, emphasizes the hand of the Creator in its design. A study of ecology shows God’s providential design in the relationships between living things and their environments.

Added Enrichment

- Feature boxes with activities, puzzles, extra information, hands-on investigations for the classroom and at home
- Short articles highlighting God’s design in Creation (93)
- Challenging homework questions to provoke thinking more deeply about concepts taught (69)
- Thought-provoking review exercises (7)
- Highlighted fun facts (127)
- Review activities to prepare for tests (38)

Evaluation

- Reading quizzes (18)
- Review quizzes (40)
- Insect collection (counts as 3 quiz grades)
- Science project background paper and investigation plan (counts as test grade)
- Tests (8), 9-weeks exam (2)
- Semester exam, final exam

➤ **RED** indicates **NEW MATERIAL**

Introduction to Life Science

- Introduction of basic terms: biology, organism, divisions of biology, respiration, excretion
- Symmetry in living things
- Observing nature: how to set up an observation notebook and observation kit
- Overview of environments: meadow, woodlands, freshwater, and marine
- Scientific method:
 - Six-step process
 - Explains process of the experimental method
 - Differentiate hypotheses, theories, and scientific laws
 - Differentiate experimental and control groups, constants and variables

Plants

- Purpose and design of flowers:
 - Functions and structures of flowers:
 - Style, anther, filament, receptacle
- Pollination and fertilization:
 - Process, provisions for fertilization, results, development:
 - Sperm cell, egg cell, embryo, endosperm, plumule, radicle
- Seed dispersal:
 - Fruit
 - Mechanical and agent dispersal
- Germination:
 - Requirements
 - Process
- Plant life expectancies:
 - Angiosperms vs. gymnosperms
- Familiar flower families:
 - Buttercup, mint, honeysuckle, parsley, milkweed, and amaryllis families
- Flower arrangements: spikes, umbels, racemes
- Monocots vs. dicots
- Leaf structure and arrangement:
 - Margins
 - Leaf arrangement, simple or compound leaves, venation

- Photosynthesis and respiration:
 - Structures, process, chemicals
 - Producers vs. consumers; uses of glucose
- Vascular system:
 - Roots
 - Vegetative reproduction
 - Xylem, phloem
 - Primary vs. secondary growth
 - Osmosis in plants
 - Capillarity
 - Transpiration

Human Anatomy & Physiology

- Outward divisions: head, trunk, appendages
- Cardiovascular system:
 - Arterioles, venules
 - Blood flow through veins
 - Pericardium
 - Pulmonary, coronary, and systemic circulation
- Respiratory system:
 - Nasal cavity, pleura
- Digestive system:
 - Enzymes, peristalsis, duodenum, rectum, feces
- Excretory system:
 - Urinary system, ureters, urethra
- Lymphatic system:
 - Neutrophils, macrophages, phagocytes
 - Main types of lymphocytes
- Integumentary system:
 - Adipose
- Skeletal system:
 - Axial and appendicular skeleton
 - Maxillary bones, mandible
 - Pelvis
 - Hinge joint, pivot joint, ball-and-socket joint
 - Fracture repair

Science: Order & Design cont.

► RED indicates NEW MATERIAL

Human Anatomy & Physiology cont.

- Muscular system:
 - Largest body system by weight
- Nervous system:
 - Impulses
- Endocrine system:
 - Gland defined, parathyroid glands, epinephrine
 - Types of diabetes mellitus
- Reproductive system: eggs, sperm
- Tissue types
- Prenatal growth and development:
 - Pictures and detailed descriptions of development at weekly intervals:
 - Conception, fertilization, uterus

A Healthy Life

- Proper nutrition:
 - Carbohydrates, fiber, protein, fats, vitamins, minerals, and water:
 - Amino acids, lipids
- Exercise:
 - Anaerobic
 - Aerobic, training heart rate, benefits
- Rest
- Outward appearance: cleanliness, grooming, sun exposure, acne, dental care
- Introduction to disease:
 - Bacteria, viruses
 - Infectious
 - Noninfectious, congenital
 - Spread of pathogens
 - Common diseases:
 - Common cold, allergies
 - Cardiovascular disease, cancer
- Substance abuse:
 - Medications, abuse
 - Dependence, withdrawal
 - Narcotics, hallucinogens, stimulants, depressants
- Emotions: adolescence
- Spiritual health: Bible study and prayer

Creation & Science

- Design in nature: introduction, history, and evidence of design
- Homology: similar structures
- Information in living things: complexity, DNA, mutations
- Natural selection: kind, speciation vs. macroevolution, specific examples
- Three views of life: “tree of life”—evolution, “lawn view,” “orchard view”—Creation science
- A Christian’s faith: what I believe and why
- History of science:
 - Materialism, Aristotle, Middle Ages
 - General and special revelation
 - Protestant Reformation
- The Bible and science: advances in modern life science
- Law of biogenesis: experiments by Redi and Pasteur
- World views and science: ordered or accidental, who determines truth, faith

- Development of modern evolutionary thought: Darwin, Lyell, uniformitarianism, missing links
- Evolution as a retreat from true science:
 - Chemical evolution, evolutionary relationships
 - Recapitulation, vestigial organs, mutations
 - Evolution of horses, whales, humans
- Mutations: most are harmful or deadly, gradualism, punctuated equilibrium

Biological Classification

- Pioneers in classification: John Ray and Carolus Linnaeus
- Classification system:
 - Kingdom, phylum, class, order, family, genus, species, scientific name
 - Six-kingdom system
- Classifying the plant kingdom—with and without vascular systems (tracheophytes and bryophytes)
- Classifying the animal kingdom—with and without backbones (vertebrates and invertebrates)

Mammals

- Characteristics of mammals:
 - Four-chambered heart
 - Hair, mammary glands, endoskeleton, warm-blooded
- Orders of placental mammals: 16 orders taught with more than 90 specific example animals
- Marsupials: mammals with pouches
- Egg-laying mammals—monotremes
- Endangered animals

Birds

- Internal anatomy:
 - Skeletal and muscular systems
 - Respiratory, cardiovascular, and digestive systems
- Senses:
 - Sight, hearing
 - Smell
- Feathers:
 - Flight and down feathers, structure, preening
 - Contour feathers, growth, molting
- Flight: motions, types of flight
- Behavior:
 - Audible communication
 - Visual communication
 - Baths
 - Dusting, anting, mobbing, running, migration
 - Courtship, egg laying, nesting, incubation
- Identifying features: wings, tails, bills, feet, field marks
- Groups: perching, birds of prey, water, game, tropical, flightless

Fish, Reptiles, & Amphibians (cold-blooded)

- Fish anatomy and groups:
 - External and internal structures of bony and cartilaginous fish:
 - Types of fins, types of scales, myomeres
 - Circulatory, digestive, excretory, nervous, and reproductive systems
- Reptile anatomy and groups:
 - External and internal structures, and characteristics:
 - Lizard and snake groups, snake movement, snake venom, tuataras

Science: Order & Design cont.

► RED indicates NEW MATERIAL

Fish, Reptiles, & Amphibians (cold-blooded) cont.

- Dinosaurs and similar creatures: descriptions of various types
- Amphibians:
 - Anatomy
 - Metamorphosis
 - Salamanders, frogs, and toads
 - Salamander life cycles, estivation
 - Caecilians (limbless amphibians)

Insects & Other Arthropods

- Common characteristics of arthropods:
 - Basic common traits:
 - Open system of circulation
- Jean-Henri Fabre—entomologist
- Insect anatomy and life cycles:
 - Complete and incomplete metamorphosis
 - Structure of compound eyes
- Insect orders:
 - Detailed description and examples for each order
 - Coleoptera (sheathed wings), Hemiptera (half-wing)
 - Homoptera (same wings), Diptera (two wings)
 - Orthoptera (straight wings), Odonata (toothed)
 - Neuroptera (nerve wings)
 - Hymenoptera (membrane wings), Lepidoptera (scale-wing)
- Insects and man: helpful and harmful characteristics of insects
- Crustacean anatomy and orders (aquatic arthropods):
 - Common anatomy
 - Orders:
 - Decapoda (ten feet)
 - Amphipoda (both legs), Copepoda (one eye), Branchiopoda (gill feet)
 - Cirripedia
 - Euphausiacea (shining bright)
 - Isopoda (equal feet), includes wood lice
- Arachnid anatomy and groups:
 - Details of common anatomy
 - Spiders, harvestmen (daddy longlegs), scorpions
 - Pseudoscorpions
 - Mites, ticks
- Centipedes and millipedes: comparison and contrast of traits

Microbiology

- Cell theory: introduction to the cell, Robert Hooke
- Cell structure:
 - Basic structures and functions:
 - Plant cell structure and differences from human and animal cells
- Algae:
 - Characteristics and types:
 - Classification; volvox, spirogyra
- Fungi:
 - Characteristics and types:
 - Classification
 - Rusts, smuts
 - Yeast reproduction

- Protozoa:
 - Leeuwenhoek, sarcodines, ciliates
 - Flagellates, sporozoa, vorticella, stentor
- Bacteria: eukaryotes and prokaryotes, examples of helpful and harmful bacteria

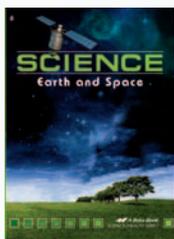
Forestry

- Tree groups:
 - Basic traits of angiosperm and gymnosperm trees:
 - Cycads, ginkgoes
- Tree structure:
 - Details of roots, stems, branches, and leaves:
 - Bark and wood as vascular tissue
 - Pith
 - Bud structure and types
 - Nodes and lenticels
 - Sun and shade leaves, leaf pigments
- Locations of American forests: introduction and geographical description of North American forests
- Branches of forestry: introductory concepts regarding forestry
- Functions and resources of forests
- Using forests: harvesting methods and renewing the resources
- Notable tree species: details and characteristics of 24 types of North American trees
- Forest conservation: Theodore Roosevelt, sustainability, reforestation, forest fires, disease, insects

Ecology

- Factors in an ecosystem:
 - Overview of factors affecting an ecosystem
 - Tolerance vs. optimum range
 - Limiting factor
 - Carrying capacity
 - Biodiversity
 - Biogeochemical cycles
- Levels of ecology: biosphere, atmosphere, lithosphere, hydrosphere, community, population
- Types of biomes:
 - Overview of traits and communities of:
 - Tundra, boreal forest, temperate deciduous forest
 - Grassland, tropical rainforest
 - Aquatic biomes
- Nutrition types: traits and types of producers and consumers:
 - Food chains
 - Trophic levels
 - Food webs
 - Special nutritional relationships: predation, symbiosis, competition, and neutralism
- Dominion and stewardship: role of man in the environment, biblical stewardship
- Dangers of modern environmentalism: bias, pantheism
- Biblical conservation:
 - Bible examples

Science: Earth & Space Grade 8



Science: Earth and Space lays a foundation for future study of the nonliving world. The text begins “from the ground up,” starting with soil science and geology. Students learn how geology and the fossil record support the biblical record of a worldwide Flood—not the hypotheses of evolution.

The exploration of the seas includes studying currents, tides, and ocean floor. An investigation of the atmosphere and processes that cause weather includes overviews of several weather phenomena and of measuring and forecasting the weather.

The solar system, stars, and galaxies are examined as the creation of God; evolutionary hypotheses of solar-system formation are briefly discussed and shown to be scientifically unsound. Students learn about man’s study and use of astronomy, including an overview of manned and unmanned spaceflight.

The text concludes with a study of environmental issues, thus teaching students to be good stewards of the natural resources God has provided.

Added Enrichment

- Feature boxes with activities, extra information, hands-on investigations for the classroom and at home
- Short articles highlighting God’s design in creation (5)
- Challenging homework questions designed to provoke thinking more deeply about concepts taught (53)
- Thought-provoking review exercises (53)
- Highlighted fun facts (142)
- Review activities to prepare for tests (28)

➤ **RED** indicates **NEW MATERIAL**

Evaluation

- Reading quizzes (23)
- Review quizzes (36)
- Science project with background paper, investigation plan, experimentation, and oral presentation (counts as 2 quiz grades and 2 test grades)
- Tests (8), 9-weeks exam (2)
- Semester exam, final exam

Introduction to Science

- Using the scientific method:
 - Three main components: hypothesizing, observation, experimentation
 - Six steps

Pedology: Soil Science

- Characteristics of soil:
 - Organic and mineral materials, humus
 - Topsoil, subsoil, bedrock
 - Texture: sand, silt, clay, loam
 - Colors: Munsell charts
 - Soil pH: pH scale
- Soil nutrients—nutrients and primary plant food elements:
 - Fertilizer composition: phosphates, nitrogen, potassium
 - Nitrogen:
 - Nitrogen cycle, nitrogen compounds
 - Nitrogen-fixing bacteria
 - Nitrifying bacteria, denitrifying bacteria
 - Phosphorus: cell division, growth, plant maturity
 - Potassium: general health of plant and disease resistance
- Air and water in the soil:
 - Ground air: pore spaces
 - Ground water:
 - Saturated, water table, artesian well
 - Aquifer, capillarity

Geology

- Structure of the earth:
 - Introduction to geology: defined
 - Crust—outer layer:
 - Covered with sediment
 - Oxygen, silicon, aluminum, iron

- Mantle—middle layer:
 - Seismic waves, upper mantle, transition zone, lower mantle
 - Moho
- Core:
 - Outer and inner core
 - Core-mantle boundary
- Movements of crust:
 - Plates, plate tectonics
 - Lithosphere
 - Development of plate tectonics theory
 - Relationship of plate tectonics to biblical record
 - Pangaea, types of faults and folds
 - Mountains: volcanic, domed, folded, fault-block
- Earthquakes:
 - Earthquakes and tremors:
 - Tectonic earthquakes, tsunamis, aftershocks
 - Seismology, faulting, elastic rebound theory
 - San Andreas Fault, focus epicenter
 - Earthquake waves: P waves, S waves, surface wave, seismograph, seismogram, locating an earthquake’s epicenter
 - Earthquake zones: circum-Pacific belt, Alpid belt
 - Earthquake strength:
 - Modified Mercalli Scale
 - Richter magnitude scale
 - Moment magnitude scale
 - Studying earthquakes:
 - Provide information about earth’s interior
 - San Andreas Fault Observatory at Depth
 - Reducing earthquake damage:
 - Fixed-base, base-isolated, and energy-dissipating systems

Science: Earth & Space cont.

► RED indicates NEW MATERIAL

Geology cont.

- Volcanoes:
 - Magma, magma chamber, cone
 - Volcanology
 - Types of volcanoes: cinder-cone, shield, composite, active, dormant, extinct
 - Location of volcanoes: Ring of Fire
 - Volcanic eruptions and ejecta:
 - Types of lava
 - Pyroclasts:
 - Volcanic ash, lapilli, volcanic blocks, volcanic bombs
 - Difference between volcanic blocks and volcanic bombs, pyroclastic flows
 - Volcanic structures:
 - Calderas
 - Lava tunnels
 - Igneous intrusions: dikes, sills, laccoliths, batholiths
- Introduction to minerals:
 - Study of minerals:
 - Mineralogy, crystals
 - Groups of minerals (halides, sulfides, sulfates, oxides, carbonates, phosphates, silicates); faces
 - Identifying minerals:
 - Surface color, streak color, luster, hardness, Mohs scale
 - Cleavage, acid test
 - Specific gravity, special properties (fluorescence, phosphoresence)
- Notable minerals:
 - Metals:
 - Ore, useful metals
 - Metallurgy, Bayer process, Hall-Héroult process
 - Iron, alloy, precious metals
 - Blast furnace, direct iron reduction
 - Gemstones:
 - Precious stones, diamond pipes, semiprecious stones
 - Simulant and synthetic gemstones
 - Methods of synthesizing: flame fusion process, pulled method, hydrothermal synthesis
- Rocks—petrology:
 - Igneous rocks:
 - Intrusive and extrusive rock
 - Coarse-grained, fine-grained
 - Porphyritic (mixed-textured), amorphous, porous
 - Sedimentary rocks:
 - Concretions, stratum, law of superposition
 - Mechanical sediments:
 - Conglomerate rock
 - Clastic sedimentary rock
 - Chemical sediments:
 - Precipitate, evaporites, salt domes
 - Organic sediments:
 - Fossil fuel, types of coal, bitumen, surface mining
 - Underground mining:
 - Longwall, continuous, and retreat mining
 - Metamorphic rocks:
 - Metamorphism:
 - Contact and regional metamorphism

- Foliated and nonfoliated rocks
 - Characteristics of metamorphic rocks
- Weathering:
 - Physical weathering:
 - Ice wedging, exfoliation
 - Chemical weathering:
 - Causes, rate
- Erosion:
 - Erosion by rain:
 - Runoff, sheet erosion
 - Gullying
 - Erosion by rivers:
 - Headwaters, load, river system, drainage basin, drainage divide
 - Tributary, floodplain, levees, meanders, oxbow lake, alluvial fan
 - Erosion by groundwater:
 - Caverns, stalactite, stalagmite, column, sinkhole
 - Dripstone, karst
 - Erosion by the sea:
 - Beaches, sea caves
 - Bars, barrier islands, promontories, sea cliff, sea arches, sea stack
 - Erosion by glaciers:
 - Continental glaciers, ice caps, valley glaciers, crevasses
 - Cirque, arête, horn, fjord, striae, till, moraine, drumlins
 - Outwash, kettles, Ice Age
 - Erosion by wind:
 - Aeolian processes, deflation, sand and dust storms, sand dunes
 - Crescentic, parabolic, and transverse dunes
 - Abrasion
 - Erosion by gravity:
 - Mass wasting, soil creep, mudflows
 - Avalanche, landslides, rockfall
 - Preventing erosion:
 - Terracing
 - Strip-cropping, breakwaters

Interpreting the Fossil Record

- Conflicting views of the beginning:
 - Special creation, evolution:
 - Big bang, theistic evolution
 - Limitations of geology: principle of uniformity
 - Geology and the Genesis Flood
 - Uniformitarianism: Charles Lyell, problems with, Charles Darwin
 - Catastrophism: Georges Cuvier
- Paleontology:
 - Fossil formation
 - Geologic column:
 - Eons, eras, periods, epochs, index fossils
 - Imaginary arrangement, circular reasoning, anomalies
 - Radiometric dating: carbon-14 dating
 - Biblical explanation of the fossil record
- Evidence of a flood:
 - Quick deposition: massive “graveyards,” polystrate fossils, unconformity
 - Living fossils: coelacanth, stasis

Science: Earth & Space cont.

► RED indicates NEW MATERIAL

Interpreting the Fossil Record cont.

- Evidence against evolution:
 - “Missing links”:
 - *Seymouria*, *Archaeopteryx*, *Tiktaalik*
 - Cambrian explosion
 - Impossibility of intermediates
- Natural selection and intermediates
- Punctuated equilibrium
- Evolution of man—a mistaken belief:
 - Man vs. ape: body structure, upright posture, cranial capacity
- Questionable intermediates:
 - Ramapithecus, Neanderthal man
 - Australopithecines, Lucy, *Homo habilis*, Skull 1470
 - *Homo erectus*, Java man, Peking man, Cro-Magnon man
- True origin of man: created in God’s image

The Seas

- Water of the seas—oceanography:
 - Characteristics of seawater:
 - Composition, salinity
 - Color, temperature, density, hydrostatic pressure
 - Ice of the seas: sea ice, icebergs, ice shelf
 - Movement of the seas:
 - Ocean currents:
 - Surface currents, gyre
 - Gulf Stream, Peru Current
 - Subsurface currents: density current, turbidity current
 - Upwelling, countercurrent
 - Waves and related phenomena:
 - Crest, trough
 - Period, whitecaps, ocean swells, breaker, surf
 - Undertow, longshore current, rip current
 - Tsunami formation, propagation, and warning systems
 - Tides:
 - High, low, spring, neap tides
 - Diurnal, semidiurnal, mixed semidiurnal
 - Geography of the seas:
 - Continental margin:
 - Continental shelf, continental slope
 - Shelf break, continental rise, submarine canyons
 - Deep ocean floor:
 - Seamount, atoll, lagoon, mid-ocean ridge
 - Abyssal plain, Mid-Atlantic Ridge, hadal zone
 - Study of the seas:
 - Introduction to oceanography:
 - Matthew Maury
 - H.M.S. *Challenger*
 - Vessels of the oceanographer:
 - Submersibles
 - Research vessel, bathyscaphe
 - Deep Submergence Vehicles, remotely operated vehicle
 - Manned undersea laboratories
 - Equipment of the oceanographer:
 - Oceanographic buoys, drift bottles, profiling floats
 - Niskin bottles, rosette, gravity corer, piston corer
 - Sonar, scuba

The Atmosphere

- Introducing the atmosphere:
 - Atmospheric composition:
 - Homosphere, heterosphere
 - Composition of air, water vapor, ozone
 - Layers by temperature:
 - Troposphere:
 - Temperature gradient, tropopause
 - Stratosphere, ozone layer:
 - Types of ultraviolet radiation
 - Mesosphere, thermosphere, exosphere:
 - Mesopause, thermopause
 - Ionosphere:
 - Cosmic rays, plasma
 - Magnetosphere:
 - Poles, magnetic field, auroras
 - Van Allen radiation belts
 - Atmospheric pressure: weight of air
- Heat and the atmosphere:
 - Balanced system:
 - Radiation, albedo
 - Insolation:
 - Factors affecting insolation
 - Perihelion, aphelion, energy budget
 - Greenhouse effect:
 - Greenhouse gases
 - Heat distribution in the atmosphere:
 - Conduction, convection, convection currents
 - Updrafts, downdrafts
 - Adiabatic heating and cooling
- Patterns of circulation:
 - Circulating currents:
 - Low pressure, high pressure, global winds
 - Convection cell, Hadley cell
 - Coriolis effect:
 - Inertia, cyclone, anticyclone
 - Earth’s wind zones:
 - Intertropical Convergence Zone (ITCZ or doldrums), horse latitudes
 - Trade winds, polar easterlies, prevailing westerlies
 - Jet streams, Rossby waves
 - Local winds:
 - Monsoon effect
 - Sea, lake, land, and forest breezes
 - Anabatic, katabatic, fall winds, and the mistral
 - Foehns, chinooks, Santa Ana winds

Weather

- Understanding weather—climate, meteorology:
 - Factors causing weather: heat energy, uneven heat distribution, water vapor
 - Atmospheric water vapor:
 - Melting, freezing, precipitation, condensation
 - Saturated, relative humidity
 - Dew and frost points:
 - Dew, frozen dew, frost
 - Condensation nuclei, frost point, deposition, supercooled, freezing nuclei

Science: Earth & Space cont.

► RED indicates NEW MATERIAL

Weather cont.

- Clouds and fog:
 - Naming clouds:
 - Based on:
 - Shape
 - Height
 - Cumulus, stratus, cirrus, and variations of these three
 - Lenticular, contrails
 - Fog:
 - Radiation and steam fog
 - Mist; advection, upslope, and freezing fog
 - Smog, photochemical smog
 - Precipitation—water cycle
 - Liquid precipitation:
 - Rain, raindrops, snowflakes, drizzle, freezing rain
 - Bergeron process, collision-coalescence process
 - Solid precipitation:
 - Sleet, snow, dendrite, hail
 - Flurries, snow squall, blizzard, whiteout, glaze, rime
 - Drought: conditions for; agricultural, hydrological, and socio-economic droughts
- Air masses:
 - Types of:
 - Maritime tropical, continental tropical
 - Maritime polar, continental polar, Arctic
 - Air-mass weather
 - Fronts and weather:
 - Warm and cold fronts
 - Stationary and occluded fronts
 - Frontal cyclones
- Thunderstorms, lightning, and tornadoes:
 - Thunderstorms:
 - Stable and unstable air, stages of development
 - Downbursts, cells, supercell
 - Squall line
 - Lightning:
 - Formation, stepped leader, thunder
 - Return stroke, dart leader
 - Types:
 - Negative and positive cloud-to-ground, hot lightning, ground-to-cloud, ball lightning
 - Tornadoes:
 - Formation, dangers
 - Mesocyclone, condensation funnel, occurrence
 - Enhanced Fujita scale, waterspout, dust devil
- Hurricanes:
 - Life of a hurricane: tropical cyclone, tropical disturbance
 - Cyclone categories:
 - Tropical depression, tropical storm
 - Saffir-Simpson Hurricane Wind Scale
 - Hurricane structure: eye, eye wall
 - Hurricane dangers:
 - Wind, inland flooding
 - Storm surge

- Measuring and forecasting weather:
 - Measuring basics:
 - Thermometer:
 - Maximum-minimum, bimetallic strip, and electrical thermometers; thermograph
 - Barometer:
 - Bar
 - Aneroid barometer, millibars
 - Hygrometer:
 - Psychrometer
 - Wet-bulb depression, hair hygrometer
 - Weather vane
 - Anemometer
 - Rain gauge, Stevenson Screen
 - Modern measurements:
 - Automated instruments, automatic weather stations
 - Transmissometer, visibility
 - Weather balloons:
 - Radiosonde
 - Sounding rocket, ceilometers
 - Radar, weather satellite
 - Summarizing weather conditions: surface weather charts, station model, isobars, isotherms
 - Predicting weather conditions: weather forecasts, supercomputers
 - Do-it-yourself forecasting: predictable patterns, analyzing clouds

Astronomy

- Solar System:
 - Structure of the solar system:
 - Orbit
 - Geocentric, Aristotle
 - Ptolemy
 - Copernicus, Galileo, Kepler
 - Heliocentric
 - Planetary motions:
 - Elliptical paths, Kepler's three laws of planetary motion
 - Astronomical units
 - Gravity and the solar system:
 - Sir Isaac Newton, law of universal gravitation
 - Origin of the solar system: Creation vs. nebular hypothesis
 - Interplanetary space: vacuum
 - Planets:
 - Mercury: speediest planet
 - Venus:
 - Earth's twin, morning and evening star
 - Retrograde
 - Earth:
 - Life-sustaining planet
 - Moon, satellite, lunar month, maria
 - Terrae, rays
 - Phases of the moon, solar eclipse, lunar eclipse
 - Mars: red planet, Phobos, Deimos, Tharsis Bulge, Olympus Mons
 - Jupiter:
 - Largest planet, Great Red Spot, Galilean satellites

Science: Earth & Space cont.

► RED indicates NEW MATERIAL

Astronomy cont.

- Saturn:
 - Second-largest, “shepherd moons,” Titan, Iapetus, Mimas, Phoebe
 - Enceladus
- Uranus:
 - Retrograde rotation
 - Titania, Oberon, Miranda, Cordelia, Ophelia
- Neptune: discovered mathematically before seen
- Planets vs. dwarf planets: Pluto and moons, Eris
- Asteroids: asteroid belt, Ceres, Trojan asteroids, near-earth asteroids
- Comets:
 - Edmond Halley
 - Halley’s comet, nucleus, coma, tail
 - Short-period comet, long-period comet
 - Kuiper belt
- Meteoroids: meteor, meteor shower, meteorites
- Constellations:
 - Celestial sphere:
 - Horizon, distance between objects, celestial poles
 - Celestial equator, circumpolar
 - Polaris, zodiac
 - Modern definition of *constellation*, asterisms
- Seasonal constellations:
 - Spring constellations
 - Summer constellations: Lyra, Vega, Summer Triangle
 - Autumn and winter constellations
 - Great Square
- Southern constellations: Centaurus and Crux
- Sun, stars, and galaxies:
 - Sun:
 - Core, photosphere, granule, sunspots
 - Supergranules
 - Chromosphere, spicules, solar flares, solar prominence
 - Transition region
 - Corona, solar wind
 - Stellar measurements:
 - Light-year
 - Parallax, stellar parallax, parsec
 - Star magnitude: apparent magnitude, absolute magnitude
 - Star categories:
 - Temperature and color, temperature and magnitude
 - Hertzsprung-Russell diagram
 - Giants, supergiants, main sequence, white dwarfs
 - Red dwarfs
 - Stars in groups:
 - Binary star, optical double
 - Open clusters, globular clusters
 - Stellar explosions:
 - Nova, supernova, pulsar
 - Neutron star
- Galaxies:
 - Milky Way, clusters, Local Group, Andromeda galaxy
 - Superclusters
 - Spiral, barred, elliptical, and irregular galaxies
 - Lenticular galaxies
- Quasars
- Nebulae

Man & the Universe

- Instruments of astronomy:
 - Visible light astronomy:
 - Telescope, refracting telescope, objective
 - Eyepiece, reflecting telescope
 - Resolution
 - Spectroscopy: visible spectrum, spectroscope, spectrogram
 - Radio wave astronomy:
 - Radio telescopes
 - Interferometry
- Astronomy and time:
 - Meridian and transits: zenith, nadir, meridian, transit
 - Day and night:
 - Sidereal day
 - Apparent solar day, mean solar day, equation of time
 - Standard solar time, summer time
 - Longer times: lunar month, solar year, week
 - Calendars:
 - Gregorian
 - Julian, Jewish
 - Ecliptic and climates:
 - Equinox, precession of the equinoxes, solstice
 - Climate zones
 - Seasons:
 - Relationship to equinoxes and solstices; lengths
 - Causes
- History of spaceflight:
 - Rockets: solid-fuel rocket, Robert Goddard, liquid-fuel rocket, Wernher von Braun
 - Race to the moon:
 - *Sputnik 1*, *Explorer 1*
 - Yuri Gagarin, Alan Shepard, John Glenn, Valentina Tereshkova
 - Gemini and Apollo Programs, Saturn V, Neil Armstrong
 - Manned space stations: Salyut program, *Skylab*, *Mir*, International Space Station
 - Space shuttle
 - Spaceflight today:
 - Nations in space
 - Private space flights
- Orbits and satellites:
 - Objects in orbit:
 - Apogee, perigee
 - Geostationary orbit, polar orbit
 - Sun-synchronous orbits, Hohmann transfer orbit
 - Unmanned satellites:
 - Astronomical, communications, weather, navigational
 - Earth observation, military satellites, GPS
 - Unmanned space probes:
 - Escape velocity

Environmental Science

- Environment and pollution:
 - Introduction to environmental science:
 - Biotic and abiotic factors, biogeochemical cycles
 - Preservationists, conservationists
 - Pantheism

Science: Earth & Space cont.

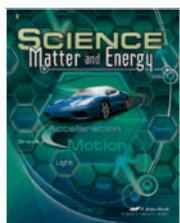
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Environmental Science cont.

- Pollution basics
 - Land pollution: landfill, reclaimed, waste-to-energy incinerator, syngas
 - Air pollution:
 - Primary and secondary pollutants, formation and dangers of temperature inversion
 - Clean Air Acts
 - Water pollution: point and non-point sources, coliform bacteria
- Global change:
 - Acid rain
 - Ozone depletion:
 - Rowland-Molina hypothesis, freons, halons
 - Ozone-depleting substances, Montreal Protocol
 - Hydrochlorofluorocarbons, fluorocarbons
- Global warming: anthropogenic global warming, Medieval Climate Optimum, Little Ice Age

- Managing our resources:
 - Biblical commands
 - Examining our resources:
 - Non-renewable and renewable resources
 - Sustainable development, environmental technology
 - Water reclamation
 - Recycling programs
- Renewable energy:
 - Solar energy:
 - Active and passive solar power, photovoltaic cells, concentrating solar power
 - Wind power:
 - Wind turbine, wind farm
 - Hydroelectric power
 - Nuclear power:
 - Nuclear chemistry, nuclear fission, nuclear chain reaction
 - Nuclear reactor, breeder reactor

Science: Matter and Energy Grade 9



Science: Matter and Energy builds a foundation for future studies in chemistry, physics, and other fields. The Christian perspective of this text naturally rejects the unproven hypothesis of evolution, recognizing special creation as the only reasonable explanation for the universe’s origin. This position is presented throughout the text and highlighted in a chapter on origins, which provides evidence *against* evolution and *for* the reality of the Genesis Creation account.

Science: Matter and Energy also recognizes God’s command for man to have dominion over creation. Thus the purpose of science becomes the application of scientific knowledge for mankind’s benefit. From chemistry to physics, the goal is to learn how man might extend his “dominion” and make better use of creation. With man’s dominion over the earth comes a responsibility to tend, manage, and conserve resources. However, the ultimate purpose of creation must not be forgotten—the earth was made for man to inhabit, and its resources were made for man to use.

Added Enrichment

- Feature boxes with extra information, articles highlighting God’s design in creation
- Classroom demonstrations with student participation (39)
- Challenging homework questions to make students think more deeply about concepts (62)

Evaluation

- Reading quizzes (20)
- Review quizzes (38)
- Science project with background paper, investigation plan, experimentation, follow-up paper, created display, oral presentation (counts as test grade)
- Tests (8), 9-weeks exam (2)
- Semester exam, final exam

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Introduction to Physical Science

- Basics of matter and energy:
 - Inertia, force
 - Properties of matter
 - Physical and chemical changes
 - Mass, weight, volume, density, state, temperature
 - Branches of physical science: physics and chemistry
- Scientific method:
 - 3-step process; theories, laws
 - Predictions: testability, repeatability

- Causality
- Limitations of science: scope, assumptions, bias, approximations
- Biblical reasons to study science

Matter and Energy

- Measuring matter:
 - Mathematics in science
 - Accuracy, precision, and significant figures
- Scientific notation
- Units:

Science: Matter and Energy cont.

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- Systems of measurement:
 - Need for systems of measurement
- Metric system/SI:
 - Definition of units: meter, liter, kilogram, second
 - Celsius temperature scale
 - Kelvin temperature scale
- Volume, density, and specific gravity:
 - Measuring volume by fluid displacement
- States of matter:
 - Atomic theory defined
 - Kinetic theory of matter:
 - Cohesion, Brownian motion, diffusion
 - Osmosis
- Solids:
 - Crystalline vs. amorphous solids
 - Properties of solids:
 - Elasticity, resilience, rigidity, plasticity
 - Hardness:
 - Mohs scale
 - Brinell hardness scale
 - Deformation of solids:
 - Stretching, compression, bending, shear, torsion
 - Hooke's law, spring constant
- Liquids:
 - Adhesion
 - Surface tension
 - Capillarity:
 - Meniscus
 - Pressure in liquids:
 - Mathematical definition; SI units
 - Gravitational pressure, Pascal's principle
 - Hydraulic press
- Gases:
 - Gas laws: Boyle's, Charles's, Amontons's
 - Atmospheric pressure:
 - Barometers
 - Physical principles
 - Applications: straws, siphons, vacuum cleaners
 - Fluid displacement:
 - Archimedes' principle, buoyancy
 - Buoyancy in liquids: floating, neutral buoyancy
 - Buoyancy in air
 - Bernoulli's principle:
 - Application to flight: forces on flight, control surfaces, streamlining
 - Other applications: hydrofoils, curve balls, carburetors
- Energy:
 - SI unit
 - Forms:
 - Radiant, mechanical
 - Energy changes:
 - Conservation of matter and energy
 - Kinetic energy:
 - Forms; calculation of translational kinetic energy

- Potential energy
 - Fundamental forces: relationship to potential energy
 - Types
 - Calculation of gravitational potential energy
- Heat and thermal energy:
 - Factors affecting thermal energy
 - Thermal equilibrium
 - Heat capacity and specific heat
 - Calorimetry
- Thermal expansion:
 - Explained
- Heat transfer: conduction, convection, radiation
 - Direction
 - Applications: Dewar flask, indoor heating
- Thermodynamics: laws of thermodynamics; mechanical equivalent of heat, Carnot engine, entropy, perpetual motion
- State changes:
 - Freezing point depression, latent heat, heat of fusion
 - Volatile, nonvolatile
 - Scientific definition of boiling; boiling point elevation, heat of vaporization
 - Vapor pressure: relationship to boiling point; critical temperature
 - Heat pumps
 - Sublimation, deposition

Chemistry

- Foundations of chemistry:
 - Chemistry and matter:
 - Brief history
 - Definition, characteristics of matter, atomic theory
 - Elements and compounds
 - History of atomic symbols
 - Inside the atom:
 - Nucleus with protons and neutrons, atomic number, electrons:
 - Quarks, electron shells, types of ions
 - Mass number, atomic mass
 - Atomic models:
 - Quantum theory, uncertainty principle, quantum numbers, Pauli exclusion principle
 - Nuclear chemistry
 - Nuclear decay
 - Fission and fusion
 - Details of process
 - Electrons and chemical properties:
 - Valence electron, periodic table of elements:
 - Periods and groups
 - Alkali metals, alkaline earth metals
 - Transition metals, inner transition metals
 - Groups IIIA–VIA
 - Halogens, noble gases
- Molecules and chemistry:
 - Compounds and mixtures
 - Molecular mass, isomers
 - Pure substance, homogeneous, heterogeneous
 - Solutions, solubility, colloids

Science: Matter and Energy cont.

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Chemistry cont.

- Chemical bonds
 - Covalent bonds:
 - Single, double, triple; Lewis structures
 - Polar and nonpolar; electronegativity, partial charge
 - Covalent network, formula unit
 - Ionic bonds:
 - Polyatomic ions; ionic crystals
 - Metallic bonds
 - Basic chemical nomenclature; types of chemical formulas
 - Intermolecular forces:
 - Types, characteristics, and relative strength
 - Effects on physical properties: solid structure, state changes, solubility
- Chemical reactions:
 - Reactants, products
 - Chemical equations, conservation of mass
 - Balancing equations
 - Chemical thermodynamics:
 - Endothermic and exothermic reactions
 - Entropy in chemical reactions
 - Chemical kinetics: activation energy, factors affecting reaction rates; catalysts
 - Chemical equilibrium: Le Châtelier's principle
 - Types of chemical reactions
 - Salts
 - Chemistry of acids and bases: pH as a measure of concentration
 - Redox reactions and electrochemistry:
 - Basic terms
 - Types and chemistry of electrochemical cells
 - Organic chemistry:
 - Uniqueness of carbon, hydrocarbon nomenclature
 - Alkanes, alkenes, alkynes
 - Aromatics, substituted hydrocarbons, soaps, and polymers
 - Biochemistry:
 - Carbohydrates, lipids:
 - Disaccharides, glycogen, structure of fats, types of cholesterol
 - Chemistry and structure of proteins, types and structure of nucleic acids
 - Metabolism:
 - Chemistry of ATP

Science vs. Evolution

- Biblical view of origins
 - Origin of time, space, matter, and energy
- History of evolutionary philosophy
 - Darwin, Lyell, *Origin of Species*, uniformitarianism
 - Thomas Huxley
 - Movement to the U.S.: Asa Gray, James Dana
 - Theistic evolution
 - Neo-Darwinism defined; evolution and secular humanism
- Evolutionary views of origins
 - Chemical evolution and big bang theory
 - Stanley Miller's experiment

- Modern opposition to evolution:
 - Rise of Creation science
 - Notable figures and organizations
- Notable scientists who believed in Creation:
 - Isaac Newton
 - William Gilbert, Samuel Morse
- Evidences against evolution from chemistry and physics:
 - Impossibility of chemical evolution, DNA complexity, interpretation of DNA
 - Inverse square laws, second law of thermodynamics, decay of earth's magnetic field
 - Complexity of the human brain; bat echolocation; electric fish

Motion

- Describing motion:
 - Brief history of developing the field of physics
 - Scalar and vectors, distance and displacement, simple vector addition
 - Speed
 - Velocity
 - Acceleration
- Newton's laws of motion
 - Second and third laws
- Forces in nature:
 - Quantitative treatment of gravity
 - Circular motion: centripetal and centrifugal force
 - Friction:
 - Causes and types of friction
 - Qualitative treatment
- Work
 - Qualitative treatment
- Power, momentum
- Simple machines:
 - Mechanical advantage, efficiency
 - Types of simple machines:
 - Lever, wheel and axle, inclined plane
 - Pulley, wedge, screw
- Waves and energy:
 - Medium, structure of waves
 - Types of waves
 - Measurement of wave properties:
 - Wavelength, frequency
 - Period, amplitude, speed
 - Wave behavior
- Sound waves:
 - Nature and transmission of sound waves
 - History of understanding of sound waves
 - Intensity, loudness
 - Pitch:
 - Audible, infrasonic, and ultrasonic sounds
 - Doppler effect
 - Quantitative treatment of speed, shock waves
- Behavior of sound waves:
 - Reflection:
 - Echoes
 - Sonar
 - Minimizing reflection: acoustics

Science: Matter and Energy cont.

➤ RED indicates NEW MATERIAL

Motion cont.

- Refraction, diffraction, interference
- Music:
 - Scientific definition
 - Interference in music:
 - Consonance, dissonance, interval
 - Beats, harmonic series, timbre
 - Resonance
 - Main types of acoustic musical instruments

Light & Color

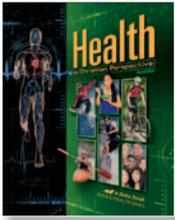
- Nature of light:
 - History of theories of light
 - Quantitative relationship between wavelength and frequency
 - Dual nature of light
 - Color:
 - Relationship to frequency and wavelength; additive and subtractive mixing, primary colors
- Behavior of light:
 - Reflection, refraction, mirage, scintillation, rainbow formation
 - Interference, diffraction, polarization
- Electromagnetic radiation:
 - Electromagnetic spectrum
 - Properties of radio waves, microwaves, infrared, ultraviolet, x-rays, and gamma rays
 - Relationship between frequency and energy
 - Laser light formation, properties, and uses
- Speed of light:
 - Constant
 - Brief overview of Einstein's special and general relativity

Electricity & Magnetism

- Electrostatics:
 - Brief history
 - Electric charge and fields, law of electric charges
 - Quantitative treatment of law of electric force
 - Transferring charges:
 - Conduction, conservation, grounding
 - Induction
 - Nature of current in gases, liquids, solids
 - Electrostatic generators:
 - Principles of operation
 - Lightning
 - Stepped leader, return stroke
 - Lightning rods
 - Leyden jar, capacitor
 - Using static electricity
- Magnets and magnetism:
 - Brief history, law of magnetic poles, magnetic fields
 - Quantitative treatment of law of magnetic force
 - Permeability

- Electron spin, domains
- Types of materials: diamagnetic, paramagnetic, ferromagnetic
- Methods of magnetization
- Electromagnets:
 - Left-hand rule, strength
- Demagnetization
- Magnetic deflection
- Magnetic earth:
 - Compass, dipping needle
 - Magnetic declination, isogonic lines
 - Magnetic inclination, isoclinic lines
- Magnetosphere
 - Celestial magnets
- Electric current:
 - Moving charges, direct and alternating current, voltage
 - Current, power, kilowatt-hours
 - Resistance, Ohm's law:
 - Reducing resistance, resistors
 - Joule heat, superconductors
- Electric circuits:
 - Components of a circuit, closed/open circuits
 - Short circuits, fuses and breakers
 - Series and parallel circuits
- Using electricity:
 - Incandescent, fluorescent, and neon lamps
 - CFLs and LEDs
 - Solenoid, telegraph, relay, and loudspeaker
 - Basic structure and motions of electric motors
- Producing electricity:
 - Electrochemical cells:
 - Batteries in series and parallel
 - Electromagnetic induction:
 - AC and DC generation
 - MHD generators, transformers
- Electronics:
 - Foundations of electronics:
 - Vacuum tubes, cathode-ray tubes, picture tubes, x-ray tubes
 - Thermionic emission, diodes, triodes
 - Semiconductor electronics:
 - How a semiconductor works, doping
 - Diodes, transistors
 - Photovoltaic cells
 - LED, semiconductor lasers
 - Integrated circuit production and application
- Electronic computers:
 - History of the computer: ENIAC and UNIVAC I
 - Analog vs. digital
 - Binary and hexadecimal number systems, logic gates
 - Processing, storage, data transfer
 - Hardware, software
 - Modern computers: PCs, servers, mainframes, and supercomputers
 - Robotics

Health Grade 9



Health in Christian Perspective will enable students to gain a deeper knowledge of the anatomy and physiology of the human body. They will be encouraged to reach out to others and to live a happy, healthy life as they maintain a consistent walk with the Lord. They will learn how to maintain their physical health through good nutrition and fitness with an emphasis on cardio-respiratory and musculoskeletal health.

A study of the nervous system in light of biblical principles encourages students to maintain good mental and emotional health. Practical aspects of safety and first aid are included in the middle of the course. Students will also learn how the immune system works to prevent disease, how to avoid drug abuse, and how to pursue a right relationship with God and others.

Added Enrichment

- Sidebars containing extra health facts, checklist for personal health, and applications of health information (185)
- Feature boxes including biblical discernment, medical careers, and articles on health-related issues (20)
- Atlas of human anatomy

Evaluation

- Reading quizzes (12)
- Review quizzes (16)
- Tests (4)
- 9-weeks exam, final exam

➤ **RED** indicates **NEW MATERIAL**

Developing a Healthy Body

- Growth and development:
 - Fetus development from conception to birth
 - Infancy
 - Adolescent development
- Endocrinology:
 - Endocrine glands and hormones:
 - Somatotropin, antidiuretic hormone, aldosterone, estrogens, testosterone, melatonin
 - Regulating metabolism, physical changes, and sleep
- Nutritional needs:
 - Gastroenterology: digestion; anatomy and physiology of organs in the digestive system
 - Gingiva, root canal, uvula, chyme
 - Macronutrients:
 - Carbohydrates, dietary fiber, proteins, fats and oils:
 - Essential amino acids; triglycerides
 - Micronutrients: vitamins, minerals, electrolytes, water
- Healthful food choices:
 - Energy from food:
 - Kilocalorie/calorie, basal metabolism, food guide pyramid
 - Nutritional balance: acceptable weight range, weight control

Maintaining Personal Health

- Cardiorespiratory fitness:
 - Cardiology:
 - Anatomy and physiology of organs in the cardiovascular system:
 - Septum
 - Blood pressure and heart rate:
 - Radial and carotid pulse, stroke volume
 - Pneumology:
 - Anatomy and physiology of organs in respiratory system
 - Lung capacity

- Musculoskeletal health:
 - Osteology: anatomy and physiology of skeletal system
 - Divisions of the backbone
 - Arm and leg bones, periosteum
 - Compact and spongy bones
 - Gliding, saddle, and ellipsoid joints
 - Myology:
 - Anatomy and physiology of muscular system:
 - Fast-twitch and slow-twitch muscle fibers
 - Flexors and extensors
 - Review 7 muscles and groups
 - Learn 10 muscles and groups
- Exercise and fitness:
 - Aerobic and anaerobic exercise
 - Strength training
 - Assessing physical fitness:
 - Cardiorespiratory endurance
 - Muscular strength and endurance
 - Measuring flexibility, body fat content
 - Total workout: warm-up, work out (training heart rate), cool down, overload
 - Energy for exercise:
 - Aerobic and anaerobic processes
 - Energy efficiency, sports nutrition, maintaining hydration
 - Benefits of exercise

Personal Hygiene

- Your protective covering: skin, below the dermis, throughout the dermis, above the dermis
- Good grooming:
 - Basic skin care, clear complexion, hair that flatters
 - Healthy nails, healthy smile
- UV protection and skin cancer prevention:
 - Types of skin cancer
 - Consumer awareness

Health cont.

► RED indicates NEW MATERIAL

Keeping a Sound Mind

- Nervous system:
 - Neurology:
 - Anatomy and physiology of organs in the nervous system
 - Neuron anatomy and types
 - Central nervous system, peripheral nervous system
 - Limbic system, somatic and autonomic nervous system
 - Sensory receptors:
 - Senses of the skin: pain, mechanoreceptors, and thermoreceptors
 - Senses of smell and taste: chemoreceptors
 - Sense of sight:
 - Anatomy of the eye, vision (rod and cone cells)
 - Defective vision
 - Sense of hearing:
 - Anatomy of the ear
 - Hearing damage:
 - Decibels, sensorineural (nerve) deafness
 - Brain and the mind
- Recognizing mental disorders:
 - Kinds of mental disorders: eating, anxiety, depression
- Good mental health:
 - Managing stress: kinds of stress, stress and body systems
 - Mental and emotional well-being:
 - Benefits of exercise, sufficient sleep, thinking right thoughts, controlling emotions, exercising your brain
- Practicing biblical discernment: biblical discernment and suicide

Practicing Personal Safety

- Household hazards:
 - Electrocuting, falls, firearms
 - Fires and burns: fire and burn prevention, fire precautions
 - Poisoning:
 - Ingested, inhaled, and absorbed toxins
 - Reducing risks:
 - Self protection
 - Protection of others, protection at work
- Recreational safeguards:
 - Sport safety:
 - Dehydration
 - Heat exhaustion, heat stroke
 - Water sports:
 - Swimming safety
 - Boating basics PWCs (personal watercraft)
 - Water rescue techniques
 - Skating
 - Wilderness recreation:
 - Poisonous plants and animals: dermatitis, poisonous snakes
 - Wilderness supplies and precautions
 - Hunting
 - Winter sports:
 - Frostbite
 - Specific safety tips
 - Recreational vehicles: snowmobiles, ATVs (all-terrain vehicles)

- Safety on the road:
 - Bicycle basics
 - Mopeds and motorcycles: determining risks, developing skills
 - Motor vehicle safety:
 - Traffic accidents
 - The leading cause of accidental deaths in the United States
 - Safe actions, courteous driving
 - Alcohol and traffic safety
- Environmental safety:
 - Natural disasters:
 - Blizzards, floods
 - Earthquakes, hurricanes, lightning, tornadoes
 - Environmental hazards:
 - Man's responsibility, pollution problems, radical environmentalism
 - Checks and balances, assessing risks, proper balance

Administering First Aid

- Emergency preparedness:
 - Knowing priorities:
 - Check, call, care
 - Check ABCs (airway, breathing, and circulation)
 - Vital signs
 - Respiratory emergencies:
 - Head-tilt and chin-lift position
 - Rescue breathing
 - Choking:
 - Unconscious victim, self, infant
 - Drowning
 - Circulatory emergencies:
 - CPR (cardiopulmonary resuscitation) instructions
 - Severe bleeding-care instructions
 - Shock-care instructions
 - Recovery position
- First aid procedures:
 - Care instructions for burns:
 - First-, second-, and third-degree burns
 - Chemical burns (eye injury care)
 - Care instructions for:
 - Convulsions, fainting
 - Dislocations, electric shock
 - Fractures: closed and open
 - Frostbite
 - Hyperthermia: heat cramps, heat exhaustion, heat stroke
 - Hyperventilation
 - Hypothermia, nosebleeds
 - Poisoning:
 - Ingested toxins
 - Inhaled and absorbed toxins
 - Snakebites: pit vipers (hemolytic), coral snake (neurotoxin)
 - Stings and bites:
 - Animal bites (rabies and tetanus)
 - Insect stings, tick bites (lyme disease)
- Strains and sprains:
 - Strain: muscle or tendon stretch or tear
 - Sprain: ligament stretch or tear

Health cont.

➤ RED indicates NEW MATERIAL

Administering First Aid cont.

- Wounds:
 - Closed wound or contusion, internal bleeding, open wound
- Incisions, abrasions
- Lacerations, punctures

Preventing Diseases

- Immunology:
 - White blood cells: leukocytes (phagocytes and lymphocytes)
 - Antibodies
 - Lymphatic system: tissue fluid, lymph vessels, lymph nodes
 - Other body defenses:
 - Bone marrow, brain, colon, lacrimal glands, liver, lungs
 - Mucous membranes, skin, stomach, tonsils and adenoids
- Infectious diseases and defenses:
 - Classification of diseases:
 - Infectious diseases, noninfectious diseases
 - Acute, chronic
 - Communicable and noncommunicable
 - Causes of infectious diseases:
 - Bacteria, viruses
 - Protozoa, fungi, parasitic worms
 - Spread of infectious diseases:
 - Airborne pathogens, contaminated surfaces, direct contact
 - Infected animals, contaminated food or water
 - Immunity against disease:
 - Gaining immunity (activated lymphocytes and antibodies)
 - Acquired, inborn, and species immunity
 - Medical defenses: vaccines, drugs, and antibiotics
- Noninfectious diseases and disabilities:
 - Leading causes of death (listed in a chart)
 - Degenerative diseases:
 - Osteoporosis
 - Dementia, Parkinson's disease
 - Biblical discernment and euthanasia
 - Genetic and congenital diseases
 - Hormonal diseases: diabetes mellitus
 - Biblical discernment and abortion
 - Immunological diseases:
 - Allergies
 - Asthma, autoimmune diseases:
 - Selected autoimmune diseases: Grave's, lupus, multiple sclerosis, psoriasis, rheumatoid arthritis
 - Nutritional diseases
 - Psychosomatic diseases
 - Diseases caused by harmful substances
 - Cancer:
 - Causes
 - Types, development
 - Treatment
 - Disabilities: impaired mobility, hearing, speech, sight
- Systemic diseases and disorders:
 - Cardiovascular diseases—leading cause of death:
 - Hypertension, arteriosclerosis

- Atherosclerosis, coronary artery disease
- Angina
- Heart attack, arrhythmia
- Ventricular fibrillation, congestive heart failure, stroke, aneurysm
- Dermatopathy:
 - Acne
 - Athlete's foot, dandruff, warts
- Endocrinopathy: ketoacidosis, hyperglycemia, hypoglycemia
- Gastrointestinal diseases and disorders:
 - Dental caries, periodontitis
 - Gingivitis, appendicitis
 - Colorectal cancer
 - Dysentery
 - Food-borne illnesses: salmonella, *E. coli*, and staphylococcus poisoning; botulism
 - Peptic ulcer
- Hemopathy: anemia
- Hemophilia
- Hepatopathy: hepatitis, viral hepatitis
- Immune-deficiency and lymphatic diseases:
 - AIDS, HIV
 - Mononucleosis
- Musculoskeletal diseases: arthritis, osteoarthritis, rheumatoid arthritis, bursitis, back pain
- Nervous system diseases and disorders:
 - Concussion
 - Amnesia, coma, meningitis, encephalitis, shingles, cerebral palsy, epilepsy
- Pneumopathy:
 - Common cold
 - Bronchitis, influenza, pneumonia, tuberculosis
- Uropathy: kidney failure, kidney stones
- Biblical discernment and organ donation
- Personal health care:
 - Medical examination: medical history, general health, physical exam
 - Disease prevention

Avoiding Drug Abuse

- Drug use and medicines:
 - Drugs as medicine: drug, medicine, OTC, prescription, antibiotics
 - Pain relievers:
 - Anesthetics
 - Analgesics:
 - Aspirin, acetaminophen, ibuprofen
 - Other common medicines: antihistamines
 - Use medicines responsibly
- Drug abuse and the body systems:
 - Effects of drug use:
 - Psychoactive drugs, physical vs. psychological dependence
 - Addiction, tolerance
 - Narcotics:
 - Opiates:
 - Morphine, codeine
 - Heroin
 - Opioids

Health cont.

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Avoiding Drug Abuse cont.

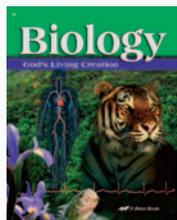
- Hallucinogens:
 - Psychedelic drugs, LSD, flashback, PCP, MDMA, ketamine
- Stimulants:
 - Cocaine, crack
 - Amphetamines
 - Methamphetamine
- Depressants:
 - Barbiturates, benzodiazepines (valium, rohypnol)
- Marijuana and related drugs:
 - Cannabinoids
- Inhalants
- Steroids
- Long-term effects of drug abuse
- Preventing drug abuse
- Alcohol and health:
 - Alcohol is the most widely abused drug in the world
 - Forms of alcohol
 - Immediate effects:
 - On the brain, liver, and other organs
 - Depressant
 - Alcohol poisoning
 - Long-term effects:
 - Alcoholism
 - Delirium tremens

- Liver and cardiovascular disease
- Gastrointestinal disorders
- Alcohol and society:
 - Crimes
 - Accidents
 - Fetal alcohol syndrome
 - Why people drink
- Tobacco and health:
 - Tobacco as a drug: nicotine
 - Effects of smoking:
 - Heart disease, respiratory problems, emphysema, cancer risks
 - Effects on nonsmokers
 - Smokeless tobacco
 - Biblical discernment and substance abuse

Pursuing Right Relationships

- Putting God first:
 - Becoming spiritually fit: continuous workout, resting in Him
 - Maintaining spiritual fitness:
 - Essential nutrition, power through prayer
 - Exercise forgiveness
- Thinking of others:
 - Maturing relationships: responsible behavior, effective communication, wholesome associations
 - Family interactions: parent-child relationships, sibling relationships
 - Close friendships: friendship qualities, influence from peers

Biology Grade 10



Biology: God's Living Creation deals with one of the most fascinating subjects known to man. Students begin with a combination of field, text, and lab work to take a closer look at plants. They will use the microscope and dissections as they study the Creator's provision for plants and animals. The anatomy and physiology of the human body are studied using the *Transvision*® view of the human body, which shows some of the body systems.

Students will look deeper into the micro-cosmos as they learn some of man's latest discoveries about the most complicated structure in all of creation: the living cell. They will see the intricate detail that God has built into living things and His master plan for transmitting information within an organism and from one generation of organisms to the next. Students will also understand just how far man still has to go to gain a complete understanding of God's living creation.

Added Enrichment

- Feature articles with information about God's design, provision, and the wonders of His creation (65)
- Laboratory exercises (25)
- Application and Critical Thinking questions for every chapter

Evaluation

- Reading quizzes (19)
- Review quizzes (36)
- Science project (counts as test grade)
- Tests (8), 9-weeks exam (2)
- Semester exam, final exam

➤ RED indicates NEW MATERIAL

Botany

- Angiosperms:
 - Introduction to biology: definition and major fields of study
 - Parts of a green plant: flowers, leaves, stems, roots

- Nitrogen cycle
- Families of angiosperms:
 - Composite, mint, parsley, rose, pea, lily
 - Mustard, nightshade, cashew

Biology cont.

► RED indicates NEW MATERIAL

Botany cont.

- Monocots and dicots:
 - Types of angiosperms: characteristics of monocots and dicots
- Grasses:
 - Cereal crops
 - Turf grasses, other grasses
- Broadleaf trees:
 - Observing trees, characteristics of trees
 - Guide to familiar American broadleaf trees by groups—bark, leaves, fruits, and crown shapes are pictured and explained
- Leaves:
 - Systems and organs in plants
 - External structure of leaves:
 - Leaf shapes
 - Parts of a leaf:
 - Stipule
 - Simple and compound leaves
 - Arrangement of leaves on stems:
 - Nodes, opposite, alternate, whorled, and rosette
 - Phototropism
 - Three types of plant tissues: structural, vascular, and meristematic
 - Structure of leaves:
 - Epidermis, mesophyll
 - Veins, parts of plant cells
 - Photosynthesis:
 - Thylakoids, light and dark reactions
 - Products of photosynthesis:
 - Factors that influence photosynthesis
 - Fall coloration of leaves and special leaves:
 - Leaf pigments, abscission layer
 - Cellulase
 - Water pressure and wilting
- Flowers, fruits, and seeds:
 - Flower parts:
 - Sepals, petals, stamen, pistil
 - Complete and incomplete flowers
 - Monoecious vs. dioecious
 - Factors affecting flowering: photoperiodism
 - Development of fruits and seeds: pollination, fertilization
 - Formation, types, and function of fruits:
 - Simple, aggregate, and multiple fruits
 - Seed dispersal
 - Structure of seeds: parts of the embryo, germination
- Stems and roots:
 - External structure of woody stems:
 - Buds, scales, bud-scale scars, growth
 - Bundle scars
 - Internal structure of woody stems:
 - Bark, pith
 - Wood:
 - Heartwood, sapwood, annual rings
 - Tracheids
 - Herbaceous stems: dicots and monocots

- Vegetative reproduction:
 - Asexual reproduction, cutting, layering, grafting, budding, culturing
- Special stems: bulbs, corms, rhizomes, stolons, tendrils, tubers, thorns
- Root systems:
 - Taproots, fibrous roots
 - Structure:
 - Root hairs, root cortex
 - Epidermis, central vascular cylinder
 - Primary and secondary growth
 - Root's absorption and transportation of water:
 - Diffusion, osmosis, capillarity
 - Adhesion, cohesion, sap stream
- Variety in the world of plants:
 - Classification:
 - Linnaeus, John Ray
 - Kingdom, phylum, class, order, family, genus, species, scientific name
 - Phylogeny, domains
 - Conifers and other gymnosperms:
 - Characteristics and reproduction of conifers, cycads, and ginkgo trees
 - Alternation of generations
 - Ferns, club mosses, and horsetails:
 - Spores
 - Structures and life cycle of ferns
 - Club mosses, horsetails
 - Lycopodium
 - Mosses and liverworts:
 - Structures of moss
 - Uses, types and life cycle of mosses
 - Liverwort characteristics
 - Algae:
 - Characteristics
 - Green algae:
 - Desmids
 - Brown algae:
 - Gulfweed
 - Yellow, red, and blue-green algae
 - Dinoflagellates
 - Fungi:
 - Importance
 - Club fungi:
 - Rust life cycle
 - Molds:
 - Parasitic molds
 - Sac fungi
 - Slime molds
 - Lichens

Human Anatomy & Physiology

- Fearfully and wonderfully made:
 - Wonders of the human body: the crown of God's creation
- Introduction to body cavities:
 - Cranial, spinal
 - Thoracic, abdominal

Biology cont.

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Human Anatomy & Physiology cont.

- Body systems: introduction to eleven systems
- Tissues:
 - Four main types
 - Tissue fluids
 - Membranes: four main types
 - Cells
 - Matrix
- Vestigial organs: brief discussion
- Prenatal development of the systems: brief discussion
- What abortion is: description of six types of abortion procedures
- Bones and muscles:
 - Detailed discussion of axial skeleton
 - Detailed discussion of appendicular skeleton
- Bones:
 - Classification
 - Structure:
 - Diaphysis, epiphysis, medullary cavity
 - Tissues
- Bone growth and development:
 - Maintenance
 - Nutrition
 - Exercise:
 - Wolff's law
 - Construction
 - Fracture and repair
- Joints:
 - Synovial fluid
 - Ligaments, types of joints, problems with joints
- Muscles:
 - Types
 - Specific muscles for moving different parts of the body
- Structure of skeletal muscles:
 - Fascia, tendons, fibers, and neuromuscular junction; muscle control
- Muscles and exercise: hypertrophy, atrophy, red and white fibers
- The nervous system:
 - Divisions of the nervous system:
 - Central nervous system:
 - Glial cells, gray and white matter, myelin, ganglia, plexus, poliomyelitis
 - Peripheral nervous system:
 - Mixed nerves
 - Autonomic nervous system
 - Nerves: median nerve, Schwann cells, multiple sclerosis
 - How neurons work:
 - Action potential
 - Synapse, neurotransmitter
 - Inhibitors
 - Parkinson's disease
 - Reflex action:
 - Reflex arc

- Parts of the brain:
 - Cerebrum:
 - Hemispheres
 - Corpus callosum
 - Cerebral cortex, lobes, cerebral palsy
 - Cerebellum:
 - Location
 - Structure
 - Function, purpose
 - Brain stem: medulla oblongata, pons, midbrain, reticular formation
 - Limbic system:
 - Thalamus, hypothalamus
 - Hippocampus, amygdala
- The mind and the brain:
 - Behaviorism
- Neurological health:
 - Caring for the nervous system:
 - REM sleep
 - Importance of avoiding alcohol:
 - Neuritis
 - Injuries to the nervous system:
 - Sciatica
 - Stroke, concussion, amnesia, coma
- Neurological diseases:
 - Tetanus, Alzheimer's disease, epilepsy
 - Dementia:
 - Acute confusion, senile dementia
 - Arteriosclerotic dementia
- Senses:
 - Somatic vs. special senses
 - Skin sensations
 - Chemical senses (taste and smell):
 - Taste bud structure
 - Primary odors
- Hearing:
 - Malleus, incus, stapes
 - Tinnitus
- Vision:
 - Protection of the eye: socket, eyelid, lacrimal glands
 - Eye movement
 - Eye structure and function:
 - Sclera
 - Uvea:
 - Choroid, ciliary body
 - Iris, pupil
 - Retina:
 - Fovea
 - Structure and function of rod and cone cells; rhodopsin; color vision, persistence of vision
 - Blind spot
 - Aqueous humor, vitreous humor
 - Lens

Biology cont.

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Human Anatomy & Physiology cont.

- Defective vision:
 - Nearsightedness, farsightedness, astigmatism, night blindness
 - Presbyopia, colorblindness
 - Glaucoma
- Nutrition and digestion:
 - Carbohydrates, proteins, lipids:
 - Incomplete proteins
 - Vitamins, minerals and water: importance, function, results of deficiencies:
 - Coenzymes
 - Scurvy, pellagra, pernicious anemia, xerophthalmia
 - Intracellular vs. extracellular fluid
 - Edema
 - Nutritional and caloric intake:
 - Breads and grains, vegetables, fruits, milk, meats and beans
 - Limiting fats, sugars and salts
 - Calories, metabolism
 - Obesity
 - Beginning of the digestive system:
 - Alimentary canal, digestion, enzymes, glands
 - Oral cavity:
 - Palate, bolus, papillae
 - Wisdom tooth, impacted, mastication
 - Esophagus: peristalsis, epiglottis
 - Stomach and intestines:
 - Stomach structure and function:
 - Hunger contractions
 - Gastric juice, hydrochloric acid, chyme
 - Intrinsic factor
 - Cardiac and pyloric sphincter
 - The liver and pancreas in digestion:
 - Bile, gallbladder
 - Bile salts, emulsification, common bile duct
 - Pancreatic juice
 - Sodium bicarbonate production by the pancreas
 - Small intestine:
 - Primary organ of digestion and absorption
 - Divisions of the small intestine
 - Villi
 - Microvilli, lacteal
 - Insulin, glucagon
 - Urea
 - Colon: function and structures
 - Gastrointestinal disorders:
 - Food poisoning
 - Dyspepsia
 - Ulcers, effects of alcohol
 - Constipation, diarrhea
 - Dysentery, colon cancer
- Circulation and respiration:
 - Blood: cardiovascular system, arteries, veins, capillaries
 - Composition of blood:
 - Plasma, red blood cells, white blood cells, platelets:
 - Plasma proteins, circulatory shock
 - Red blood cell production, leukemia
 - Blood types: antigens or agglutinogens, universal donors and recipients, Rh factor
 - Design of the heart:
 - Structure:
 - Layers, valves, and skeleton
 - Blood flow:
 - Through the heart
 - To the heart
 - Types, symptoms, and treatment of heart failure
 - Heart beats, detailed structure and function of cardiac muscle, electrical system
 - Circulation of blood:
 - Arteries, veins, and capillaries:
 - Structure of blood vessels
 - Details of systemic circulation
 - Pulmonary circulation
 - Portal and renal circulations
 - Atherosclerosis
 - Blood pressure and pulse
 - Cardiovascular health: leading cause of death, treatment
 - Anatomy and function of respiratory system:
 - Types of respiration: external, internal, and cellular
 - Organs of respiration:
 - Nasal meatuses
 - Throat structures
 - Trachea, bronchi
 - Lungs:
 - Bronchitis, pneumonia, bronchial asthma
 - Pleural membrane:
 - Pleurisy
 - Diaphragm
 - The breathing process:
 - Role of intercostal muscles
 - Control by the medulla oblongata
 - Lung capacity:
 - Vital capacity
 - Tidal volume
 - Respiratory diseases:
 - Common cold, influenza, tuberculosis, emphysema, lung cancer
 - Cystic fibrosis
 - Integumentary, excretory, and endocrine systems:
 - Introduction: body's design for maintaining homeostasis
 - Integumentary system:
 - Purpose

Biology cont.

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Human Anatomy & Physiology cont.

- Structure:
 - Psoriasis, keratin in skin, skin pigments
- Tanning, sunburn
- Hair structure
- Sebaceous glands
- Details of sweat glands
- Excretory system:
 - Kidneys:
 - Function, regulation, structures, failure, dialysis
- Endocrine system:
 - Endocrine vs. exocrine glands
 - Hormones:
 - Hormone receptors
 - Pituitary gland:
 - Hypothalamus, somatotropin
 - Disorders: pituitary gigantism, pituitary dwarfism, acromegaly
 - Gonadotropins
 - Thyroid and parathyroid glands:
 - Thyroxine
 - Thyroid disorders:
 - Cretinism, hypothyroidism, hyperthyroidism
 - Simple goiter
 - Pancreas (endocrine function): islets of Langerhans, insulin, glucagon, diabetes mellitus
 - Adrenal glands: epinephrine, steroid hormones, cortisol, aldosterone
 - Gonads:
 - Hormones
 - Gametes
 - Adolescence, secondary sex characteristics
 - Pineal gland: melatonin
- Disease and the body's immune system:
 - Introduction: disease, microbes, pathogen, infectious and noninfectious, acute, chronic
 - Noninfectious diseases: degenerative, immunological, hormonal, congenital and genetic, nutritional, harmful substances, cancer
 - Infectious diseases:
 - Communicable and noncommunicable
 - Bacteria:
 - Structure:
 - Plasmids
 - Types, variations and shapes, reproduction
 - Disease:
 - Germ concept of disease, Koch's postulates
 - Pathogenic activity
 - Viruses:
 - Introduction
 - Replication, types, diseases
 - Protozoa, fungi, parasites
 - How infectious diseases are spread:
 - Droplet infection, carrier

- Vector, venereal diseases
 - Incubation
- Preventing the spread of disease: epidemic, vaccination
- Immune system:
 - Overview, white blood cells
 - Histamine, interferon
 - Antibodies
 - Table of white blood cell types
 - Lymphatic system:
 - Lymph, vessels, ducts, nodes
 - Structure and function of lymph nodes
 - Other organs
 - Special defenses, immunity, immune deficiencies:
 - Skin barrier, mucous membranes, lysozymes, fever, microorganisms of digestion
 - Acquired immunity, innate immunity:
 - Serum
 - Immune deficiency diseases (HIV, AIDS)
 - Medical defenses against disease:
 - Immune therapy
 - Chemotherapy, antibiotics
 - Prevention: nutrition, rest, exercise

Life Sciences: Methodology & Philosophy

- Natural history and scientific investigation:
 - Natural history through the ages:
 - Bible beginnings, Hebrews
 - Greeks:
 - Anaximander, Plato, Aristotle
 - Romans:
 - Pliny, Galen
 - Ancient science vs. the Bible
 - Middle Ages:
 - Nestorians
 - Modern science: Protestant Reformation, advances in biological sciences, microscopy, cell theory
 - Biology and scientific investigation:
 - Scripture and scientific investigation, scientific method
 - Repudiation of spontaneous generation, law of biogenesis
 - Limitations of science—scientism
- Evolution—a retreat from science:
 - Science and faith: great founders of science believed in God and creation
 - Rejecting the truth:
 - Darwin and Lyell, natural selection
 - Effects of naturalism
 - Paleontology:
 - Evidence against evolution, speciation, macroevolution, fossils
 - Transitional forms and lack thereof
 - Punctuated equilibrium hypothesis
 - Geologic column, Cambrian explosion
 - Coelacanth, *Archaeopteryx*, horse series
 - Hominid fossils, Neanderthal, Cro-Magnon

Biology cont.

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Life Sciences: Methodology & Philosophy cont.

- Biological evidence against evolution:
 - Impossible transitional forms:
 - Avian respiratory system
 - Homology
 - Molecular biology: design and complexity
 - Genetics: limited variety, mutations
 - Natural selection and genetic variety:
 - Peppered moth
 - Pesticide-resistant insects, antibiotic-resistant bacteria
 - Bacterial proliferation
 - Embryonic recapitulation
 - Why evolution cannot be properly called a science
 - Threat of evolution to modern science

Ecology

- Introduction of basic terms: ecology, habitat, biotic and abiotic factors
- Levels of ecology: biosphere, biomes, ecosystems, community, population, organism
- Influences in the ecosystem: biodiversity, carrying capacity, types of abiotic and biotic factors
- Nutritional relationships in an ecosystem:
 - Producers and consumers, trophic level, food chain, food web, niches
 - Energy flow, pyramid diagrams
- Special nutritional relationships:
 - Symbiosis, predation, competition
 - Amensalism
 - Neutralism
 - Herbivory
- Nutrient cycles:
 - Hydrologic, atmospheric, sedimentary cycles
 - Carbon-oxygen, phosphorous cycles
- Major biomes:
 - Tundra, northern coniferous forest, temperate deciduous forest
 - Grassland, desert, tropical rain forest
 - Aquatic biomes:
 - Freshwater
 - Marine:
 - Estuary
- Ecological succession and man's role:
 - Primary succession, secondary succession
 - Dominion and stewardship

Zoology

- Mammals:
 - Characteristics of animals, vertebrates, and mammals:
 - Mobility, diversity, symmetry
 - Details of mammal reproduction
 - 18 mammal orders: discussed with representative animals
 - Extinct mammals

- Birds:
 - Feathered vertebrates:
 - Characteristics for flight
 - Backyard and roadside birds
 - Groups of birds:
 - Perching, birds of prey, swimming and wading, game, tropical, flightless
 - Extinct birds
 - Avian anatomy and physiology:
 - Feathers, skeletal and muscular systems
 - Nervous system: brain, senses
 - Food and digestion:
 - Intestine, cloaca, bursa of Fabricus
 - Excretory system
 - Circulatory system:
 - Nucleated red blood cells
 - Details of respiratory system
 - Family life of birds:
 - Migration, courtship
 - Mating and fertilization
 - Egg, nesting, incubation
 - Care of young
- Reptiles and amphibians:
 - Reptiles:
 - Cold-blooded, similar traits
 - Lizards: habitat, sizes, poisonous lizards, colorful, detached tails and other defenses, and eating habits
 - Snakes:
 - Sizes, methods of locomotion, scaly skin
 - Sense organs:
 - Scale-covered eyes, hearing (quadrate bone)
 - Smell: Jacobson's organ
 - Design for feeding, groups of snakes, venom, snakebite treatment
 - Turtles:
 - Reptiles with shells
 - Characteristics:
 - Tympanic and nictating membranes
 - Groups
 - Crocodylians
 - Tuataras: parietal eye
 - Dinosaurs and similar creatures: extinct reptiles, types and characteristics
 - Amphibians:
 - Vertebrates with a double life:
 - Characteristics:
 - Three-chambered heart
 - Frogs and toads:
 - Coloring
 - Toxic skin secretions
 - External fertilization
 - Development and metamorphosis
 - Anatomy: head, oral cavity, body systems

Biology cont.

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Zoology cont.

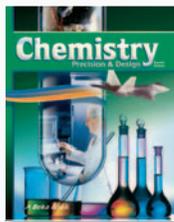
- Salamanders:
 - Reproduction and metamorphosis:
 - Spermatophore, paedomorphosis
 - Sizes; notable salamanders
- Caecilians
- Fish:
 - Bony fish:
 - Abundance and importance
 - Detailed study of anatomy and physiology
 - Cartilaginous fish: sharks, rays, and chimaeras; lampreys, hagfish
- Arthropods:
 - Common characteristics, classes
 - Insects:
 - Life cycle of insects
 - Grasshopper anatomy and physiology
 - Orders of insects and their economic significance: 8 of the more than 25 orders are taught
 - Insects and man
- Arachnids:
 - Spiders:
 - External anatomy
 - Internal anatomy, reproduction
 - Harvestmen, scorpions, mites, and ticks
 - Centipedes and millipedes
- Crustaceans:
 - Anatomy and life cycle of crayfish
 - Other crustaceans
 - Extinct arthropods
- Other invertebrates:
 - Mollusks:
 - General characteristics
 - Bivalves, gastropods, cephalopods
 - Echinoderms:
 - Starfish anatomy
 - Rotifers: parthenogenic
 - Coelenterates and porifera:
 - Coelenterates: hollow-intestined invertebrates, polyp, medusa, hydra, jellyfish, sea anemones, corals
 - Porifera (sponges):
 - Anatomy and physiology
 - Annelids:
 - Earthworms:
 - Characteristics and anatomy and physiology
 - Sea worms
 - Leeches
 - Flatworms and roundworms:
 - Platyhelminths:
 - Anatomy of planarians, flukes, and tapeworms

- Nematodes:
 - Filaria, hookworm, trichina, ascaris
- Protozoa:
 - Flagellates:
 - Euglena:
 - Pellicle, binary fission
 - Trypanosome
 - Sarcodines:
 - Amoeba
 - Foraminifera, radiolaria
 - Ciliates: paramecia, other ciliates
 - Sporozoans

Cellular & Molecular Biology

- Cytology—design and function of cells:
 - Variety and complexity of cells:
 - Discovery of cells
 - Variety in cells, complexity of cells
 - Design of cells:
 - Details of cell structure and organelles
 - Life and work of cells:
 - Maintaining life, photosynthesis and cellular respiration
 - Active transport, cell movement, cilia and flagella
 - Cell cycle and mitosis, chromatin, cell death
- Heredity: continuity of life:
 - God's provision for the continuity of life:
 - Heredity, genes
 - Differentiation, sexual reproduction, meiosis
 - Classical genetics:
 - Mendel's experiments, law of dominance, genotype and phenotype
 - Punnett squares, hybrids and hybridization, law of segregation
 - Codominance, law of independent assortment, linkage
 - Punnett square for dihybrid cross, Sutton's hypothesis
 - Morgan's research, sex chromosomes, sex-linked traits
 - Human genetics:
 - Dominant gene inheritance, codominance
 - Multiple allele inheritance
 - Pleiotropy and polygenic inheritance
 - Sex-linked disorders, genetic advances, eugenics
- DNA—regulation of life:
 - DNA:
 - Deoxyribonucleic acid
 - Watson and Crick, chromosomes, storage
 - Structure of RNA and DNA, bases, base pairing
 - Activities of DNA:
 - "Central dogma of molecular biology," DNA replication
 - RNA and transcription, constructing proteins, translation
 - Mutations

Chemistry Grade 11



Chemistry: Precision and Design explores the many branches of chemistry to discover the ingenious structure and orderly function of God's creation. The Christian perspective of this text rejects evolution and recognizes special creation as the reasonable explanation for the origin and design of the universe. Although chemistry has been less permeated by evolutionary doctrine than biology or geology, one's view of origins does affect how he approaches the science of chemistry and how he applies chemical principles to societal issues.

Chemistry: Precision and Design recognizes God's command for man to have dominion over the creation, and its goal is to teach how man might extend his "dominion" and make wiser use of the physical creation. This text presents chemistry as a foundational science and includes chapters on nuclear and organic chemistry. It seeks not only to give students a solid basis in chemical principles, but also to help students understand the practical application of these principles.

Added Enrichment

- Feature boxes include:
 - Additional information on topics of interest
 - Chemistry in everyday objects
 - Highlights of God's design in the chemistry of His creation
 - Innovations in chemistry
 - Chemical explanations of environmental issues
 - Laboratory exercises (30)

Evaluation

- Reading quizzes (18)
- Review quizzes (27)
- Science project (counts as test grade)
- Tests (8), 9-weeks exam (2)
- Semester exam, final exam

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Chemistry: An Introduction

- Branches of chemistry, importance of chemistry
- Purpose of science
- Measurement in chemistry:
 - F.P.S. and metric system of (SI) units
 - Prefixes, measuring length, volume, mass, temperature, and other quantities
 - Scientific notation, precision and accuracy
 - Uncertainty, significant figures in measurement and calculation
 - Problem solving strategies, unit conversion
- Matter:
 - States of matter, melting and boiling point, classification
 - John Dalton and atomic theory
 - Laws derived from atomic theory
- Energy and matter:
 - Quantitative treatment of kinetic energy
 - Energy changes in chemical reactions
 - First and second laws of thermodynamics
 - Introduction to spontaneity
 - Endothermic and exothermic
- Careers in chemistry

Matter

- Properties and changes of matter:
 - Heterogeneous and homogeneous matter
 - Properties of matter
 - Physical and chemical changes
 - Separation of mixtures
- Elements:
 - Relative abundance of elements
 - Element symbols and names

- Subatomic particles:
 - Discovery of the electron, proton, and neutron
 - Other subatomic particles:
 - Neutrino
 - Positron, meson
- Atomic number, mass number, isotopes, and ions
- Atomic mass:
 - Atomic mass units
 - Mass spectrometer, mass spectrum

Stoichiometry

- Formulas and names: types of chemical formulas, naming binary molecular compounds
- Naming ionic compounds: names of ions, determining empirical formulas
- The mole:
 - Molecular masses
 - Relative masses and Avogadro's number, mole, molar mass
- Balancing chemical equations:
 - Equations, reactants, products, law of conservation of mass
 - Steps for balancing equations
- Classification of chemical reactions:
 - Combination (synthesis), decomposition, single displacement (substitution), and double displacement reactions
 - Net ionic equations
- Quantitative relationships from the balanced equation:
 - Mole relationships, equivalencies in chemical reactions
 - Limiting reactant, mass relationships in chemical reactions

Chemistry cont.

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Gases

- Kinetic-molecular theory:
 - Five assumptions of kinetic-molecular theory
- Gas pressure:
 - Pressure, barometer
 - Standard atmosphere, manometers
- The gas laws:
 - Ideal gas
 - Boyle's law, Charles's law, combined gas law
 - STP, Gay-Lussac's law
 - Avogadro's law, molar volume, ideal gas equation
- Diffusion, partial pressures, and stoichiometry:
 - Diffusion
 - Rates of diffusion, Graham's law, partial pressure
 - Dalton's law of partial pressures, stoichiometry and gases
 - Standard and nonstandard conditions: reactions with gases

Chemical Thermodynamics

- Energy:
 - Kinetic and potential energy
 - System, surroundings, internal energy
- Heat in chemical reactions:
 - Enthalpy
 - Endothermic and exothermic reactions
 - Calorimetry
 - Specific heat, heat of reaction, thermochemical equation
 - Standard state, enthalpy of formation, mass-heat calculations
- Heat and changes of state: heat of fusion, heat of vaporization
- Entropy: second law of thermodynamics

Light, Electrons, & Atomic Structure

- Nature of light:
 - Property of waves:
 - Crest, trough, wavelength, amplitude, frequency, speed
 - Classical theories of light, electromagnetic wave, speed of light, electromagnetic spectrum, quantum theory of light
 - Photon, wave-particle duality
- Electrons and the structure of the atom:
 - Spectrometer
 - Line spectra, continuous spectra, hydrogen spectrum
 - Introductory quantitative treatment of Bohr model, details of energy levels, ground state, excited state, quantized, matter waves
 - Schrödinger's equation
 - Uncertainty principle
 - Detailed description of electron-cloud model
- Electron configuration and quantum numbers:
 - Probability contours, orbital shapes, electron configuration
 - Four quantum numbers, Pauli exclusion principle, Hund's rule
 - Valence electrons
 - Lewis structures

Periodic Table

- Historical development of the periodic table:
 - Döbereiner's triads, Newland's octaves
 - Periodic law
 - Mendeleev's table
- Classification of the elements:
 - Group, period
 - Nonmetals, metals, semimetals, representative element, transition and inner transition metal
 - Brief description of several groups (alkali metals, etc.)
- Periodicity of chemical properties: periodic properties of elements in the alkali and alkaline earth metals, combining capacity
- Electron configurations and the periodic table: correlations between the two
- Periodic properties of the elements: atomic size, ionic size, ionization energy, metallic character, electron affinity, electronegativity

The Chemical Bond & Intermolecular Forces

- Types of chemical bonds:
 - Octet rule, explanation of ionic bonding, ionic crystalline solids
 - Explanation of covalent bonding, nonbonding and bonding electrons
 - Single, double, and triple bonds
 - Network covalent substances, metallic bonds
 - Polar and pure covalent bonds, dipole
- Shapes and properties of molecules:
 - Lewis structures, delocalized electrons, resonance
 - Molecular shapes, effect of shape on polar and nonpolar molecules
- Intermolecular forces: dipole-dipole, London forces, hydrogen bonds
- Crystals: amorphous and crystalline solids
- Unit cells, close packing

Selected Nonmetals & Their Compounds

- Hydrogen: most abundant element in universe, properties, preparation, reactions, and uses
- Oxygen: occurrence, properties, preparation, reactions, and uses, hydrogen peroxide, free radicals
- Nitrogen: occurrence, properties, preparation, reactions, and uses
- Phosphorus: occurrence, properties, preparation, reactions, and uses; phosphates
- Sulfur: occurrence, properties, preparation, reactions, and uses
- Halogens:
 - Occurrence, properties, preparation, reactions, and uses of stable halogens
- Noble gases:
 - Occurrence, properties, compounds, and uses

Selected Metals & Semimetals

- Metallurgy:
 - Ore
 - Processing ore
- Alkali metals:
 - Occurrence, properties, preparation, and uses; alkali metal compounds

Chemistry cont.

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Selected Metals & Semimetals cont.

- Alkaline earth metals:
 - Occurrence, properties, preparation, and uses
- Iron:
 - Occurrence
 - Properties, production, steel refining, annealing, hardening, and tempering
- Copper:
 - Occurrence, properties, preparation, and uses
- Precious Metals:
 - Occurrence, properties, preparation, and uses of selected precious metals
- Aluminum:
 - Occurrence, properties, chemistry of preparation, and uses; thermite process
- Other metals: lead, titanium, and uranium
- Important semimetals and their compounds:
 - Silicon and germanium:
 - Occurrence, properties, preparation, and uses
 - Semiconducting properties, silicates, glass, silicones
 - Boron

Solutions & Colloids

- Introduction to solutions:
 - Solution, solvent, solute
 - Miscible and immiscible
 - Hydrated, solvated, dissociation and ionization
 - Factors affecting solution rates
 - Rules for solvent-solute interaction
- Behavior of solutions:
 - Crystallization, dynamic equilibrium
 - Solubility
 - Saturated, unsaturated, supersaturated
 - Effect of temperature
 - Effect of pressure on solubility, heat of solution
- Measuring solution concentration:
 - Generic concentration expression
 - Molar concentration or molarity, dilution, molality
- Colligative properties:
 - Vapor pressure:
 - Effects of solute, vapor pressure and changes of state
 - Boiling point elevation and freezing point depression
 - Electrolytes and colligative properties
 - Osmotic pressure
- Colloids:
 - Tyndall effect, Brownian motion
 - Types of colloids
 - Soaps and detergents

Chemical Kinetics

- Introduction to chemical kinetics: reaction rate, collision theory
- Concentration, temperature, and reaction rate:
 - Quantitative treatment
 - Activation energy
- Transition states and energy changes:
 - Transition state theory, activated complex
 - Potential energy in endothermic and exothermic reactions

- Effects of a catalyst:
 - Alternate pathway with lower activation energy
 - Energy changes in catalyzed reactions, types of catalysts, inhibitors
 - Enzymes
- Reaction mechanisms: steps to a reaction, chain mechanisms

Chemical Equilibrium

- Reversible reactions:
 - Chemical equilibrium
 - Equilibrium concentrations
- Le Chatelier's Principle: concentration changes, pressure changes, temperature changes, effects of a catalyst

Acids, Bases, & Salts

- Nature of acids and bases:
 - Characteristics of acids and bases
 - Arrhenius concept, Brønsted-Lowry concept
 - Conjugate acids and bases, naming acids and bases
 - Polyprotic acids, acid and base anhydrides
- Strengths of acids and bases: strong and weak acids and bases
- Acids in chemical reactions:
 - Reactions with bases—neutralization, salts
 - Reactions with carbonates, bicarbonates, and metals
- Equivalent and normality: equivalent mass of acids and bases, normality
- Ionic equilibrium in solution:
 - Ionization of water
 - pH scale
 - pOH scale, pH measurement, acid-base indicators
 - Acid-base titrations: titration, equivalence point, end point
 - Hydrolysis and buffers: principles of hydrolysis, characteristics of buffers

Oxidation-Reduction Reactions & Electrochemistry

- Oxidation and reduction processes:
 - Principles of oxidation and reduction, oxidizing and reducing agents
 - Redox reactions, strength of oxidizing and reducing agents
- Electrochemical reactions:
 - Electric current, electrolyte, anode, cathode
 - Electrolysis:
 - Molten sodium chloride
 - Water, aqueous salt solution
 - Half-reaction
 - Electroplating
 - Voltaic cells:
 - Construction, activity series, salt bridge
 - Electrode potentials, standard electrode potential
 - Sign conventions of anodes and cathodes

Nuclear Chemistry

- Radioactivity:
 - Changes in the nucleus—discovery
 - Review of the nucleus
 - Stable and unstable, nuclides
 - Radiation, radioactivity, types of radioactivity

Chemistry cont.

➤ RED indicates NEW MATERIAL

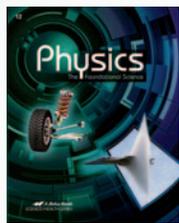
Nuclear Chemistry cont.

- Nuclear stability:
 - Density of the nucleus, strong nuclear force
 - Radioactive decay
 - Nuclear mass defect, nuclear binding energy, electron volt, binding energy per nucleon
- Nuclear reactions:
 - Important rules
 - Details of alpha, beta, and gamma decay; neutron radiation
 - Penetration ability
 - Half-life
 - Activity, units of measurement
 - Radioactive decay series, bombardment reactions
 - Particle accelerators, transuranium elements
- Effects of radiation on matter:
 - Ionizing radiation, effects on living tissue
 - Detecting radiation, measuring radiation
 - Health effects, sources of exposure
- Nuclear fission and fusion:
 - Discovery
 - Details of chain reaction
 - Critical mass
 - Atomic bomb
 - Nuclear reactor, enrichment
 - Safety
 - Accidents and meltdown, risks
 - Waste, breeder reactor
 - Chemistry of nuclear fusion, proposed confinement methods

Organic Chemistry

- Introduction to organic chemistry: carbon bonding, isomer, structural formula, functional group
- Hydrocarbons:
 - Detailed overview of alkanes, alkenes, alkynes, aromatic hydrocarbons: structure, nomenclature, and reactions
 - Saturated and unsaturated, alkyl groups, benzene
 - Sources of hydrocarbons
- Substituted hydrocarbons:
 - Alcohols, carboxylic acids, esters:
 - Nomenclature, reactions
 - Aldehydes and ketones, amines, amides
 - Other substituted hydrocarbons:
 - Haloalkanes
 - Epoxides, thiols
- Polymer chemistry:
 - Monomer, polymerization
 - Polymers by chemical structure:
 - Polyethylene, vinyls, polyesters, polyamides (nylon), polycarbonate, silicones
 - Biological polymers:
 - Protein, cellulose, chitin, glucose, and DNA
- Biochemistry:
 - Proteins and amino acids, peptide bonds
 - Carbohydrates, sugars, mono-, di-, and polysaccharides
 - Fats, lipids, fatty acids, oils:
 - Saturated and unsaturated
 - Saponification

Physics Grade 12



Physics: The Foundational Science describes the laws that govern the interactions between matter and energy. Clear and thorough explanations penetrate the most perplexing questions. Whenever possible, the principles of physics are illustrated by everyday experience and practical devices. Numerous illustrative problems are solved in detail.

This course will play an important role in showing students the harmony between scientific knowledge and Christian belief. The premise of the book is that we live in a God-created world governed by laws discoverable by reverent scientific inquiry. Issues of vital importance to Christians are handled in depth.

Physics: The Foundational Science adopts the traditional procedure of starting with solids, liquids, and gases—tangible things familiar to students. By putting the study of matter first, this course offers a smooth transition between chemistry and physics. An extended treatment of mechanics follows so that the student will be well prepared for further study in physics and engineering. While taking a traditional approach, this text more than adequately covers the most recent developments in physics for a broad range of topics: from particle physics to electronics and from lasers to relativity. The emphasis throughout is upon solid advances in knowledge rather than upon theoretical speculation.

Added Enrichment

- Feature boxes include:
 - Information on physics in action in the everyday world (10)
 - Articles highlighting Christian physicists and their contributions (6)
 - Information about related physics topics (3)
 - Key symbols and abbreviations at the beginning of each chapter
 - Key equations listed at the end of each chapter
 - Laboratory exercises (20)

Evaluation

- Reading quizzes (23)
- Review quizzes (42)
- Science project includes background paper, investigation plan, experimentation, follow-up paper, and oral presentation (counts as 2 quiz grades and 2 test grades)
- Tests (8), 9-weeks exam (2)
- Semester exam, final exam

➤ **RED** indicates **NEW MATERIAL**

Introduction to Physics

- Nature of science:
 - Branches of science, man's dominion, God's revelation
 - **Classical and modern physics**
- The Scientific Method: cogitation, observation, experimentation, scientific method, hypothesis, data
- Measurement:
 - Units of measurement:
 - **Fundamental and derived quantities**
 - Systems of units:
 - FPS, MKS
 - **CGS**
 - Standards of measurement:
 - Length, mass, time
 - **Need for consistent standards**
 - Scientific notation
 - Measurement calculations: metric-metric conversions, calculations with physical qualities, dimensional analysis
 - Significant digits:
 - Determining, calculation rules, accuracy and precision
 - **Tolerance, error of measurement, systematic and random errors**
 - Mathematical techniques:
 - Fractions, literal equations, proportions
 - **Steps in working physics problems**

Matter

- Nature of matter:
 - Characteristics:
 - Inertia
 - Mass, weight, density, specific gravity

- Pure substances and mixtures:
 - Molecule, elemental molecule, compound, mixtures
 - Homogeneous, heterogeneous, solid, liquid, gas, plasma
- Composition of matter:
 - Atom, nucleus, proton, atomic number, neutron, mass number
 - Isotope, atomic mass, atomic mass units
 - Electron, ion, anion, cation, element, periods, groups
 - Valence electrons
- Elementary particles:
 - Einstein's equation, photons, mass gain, nuclear mass defect
 - Subatomic particles
 - **Elementary particles**
 - Quarks
 - **Hadrons, mesons, baryons, gluon**
 - **Leptons**
 - Neutrino, positron, gamma radiation
 - **Pair production**
- Particle reactions:
 - **Antiparticles, antimatter, annihilation, electron capture**
 - Heavy atoms
 - Radioactive decay, half-life
 - **Reaction implications**

Liquid State

- Characteristics of a liquid:
 - Surface tension
 - Adhesion, cohesion
 - Capillarity:
 - **Capillary tubes, meniscus**

Physics cont.

► RED indicates NEW MATERIAL

Liquid State cont.

- Hydrostatics:
 - Law of liquid pressure:
 - Force, pressure
 - Defined, equation, Pascal's vases, water head, lateral force
 - Pascal's principle: transmission of liquid pressure, hydraulic device
 - Archimedes' principle: derivation, buoyant force
- Hydrodynamics:
 - Principle of viscosity: poise
 - Principle of continuity:
 - Ideal liquids
 - Cavitation, laminar flow, eddy currents, volume flow rate
 - Bernoulli's principle: velocity and pressure, lateral pressure

Gaseous State

- Air pressure:
 - Gases in the air, vacuum, atmospheric pressure
 - Gases compared to liquids:
 - Archimedes' principle, Bernoulli's principle, airfoil
- Barometers:
 - *Horror vacui*, Pascal's discovery
 - Standard atmospheric pressure
 - Gauge and absolute pressure
 - Aneroid barometer
- Gas laws:
 - Boyle's law, inverse proportion, Charles's law
 - Absolute zero, absolute temperature, direct proportion
 - Combined gas law, Avogadro's law, mole, Avogadro's number
 - Universal gas constant, ideal gas law
- Pneumatic devices: entrained, water and exhaust pumps, compressors, siphon

Solid State

- Characteristics of solids:
 - Elasticity, plasticity
 - Rigidity, resilience, elastic limit
 - Mechanical working, forging, rolling, malleability, drawing, ductility
- Moduli of deformation:
 - Hooke's law: tensile force, restorative force
 - Forces of deformation: stress, strain
 - Tensile stress:
 - Tension, Young's modulus, proportional limit, elastic limit
 - Ultimate tensile strength, breaking point, brittle, compression
 - Shear stress and volume stress

Introduction to Motion

- Kinematics: translational, rectilinear, and curvilinear motion
- Speed and velocity:
 - Rates of motion:
 - Velocity
 - Constant velocity, uniform, variable velocity, sign convention
 - Velocity equations: change in position over time, graph of displacement vs. time, instantaneous velocity
- Acceleration:
 - Types of acceleration: average, uniform, variable
 - Acceleration equations:
 - Graph of velocity vs. time, instantaneous acceleration, deceleration

- Horizontal motion: final velocity, average velocity, displacement, common equations
- Vertical motion:
 - Free-fall acceleration, effect of air resistance, terminal velocity

Vectors & Projectile Motion

- Introduction to vectors:
 - Vector properties
 - Parallel, antiparallel, collinear, perpendicular
 - Skewed, vector diagram, concurrent vectors
 - Resultant
- Vector composition of collinear vectors
- Vector composition of perpendicular vectors:
 - Parallelogram method
 - Pythagorean method:
 - Magnitude
 - Direction
- Vector composition of skewed vectors:
 - Parallelogram method: law of cosines, law of sines
- Vector resolution
- Vector composition revisited: component method
- Projectile motion:
 - Projectile motion and gravity, rate of fall, final velocity, trajectory
 - Effect of air resistance, critical velocity
 - Escape velocity

Forces in Nature

- Newton's three laws of motion:
 - Newton's first law:
 - Inertia, force
 - Friction
 - Alternative formulations
 - Newton's second law: determinants of force, units of force, meaning of mass, mass vs. weight
 - Newton's third law: action-reaction
- Friction—the cause, kinetic and static friction
- Laws of kinetic friction, normal force:
 - Coefficients of friction: coefficients of kinetic and static friction
 - Reducing friction: minimizing roughness, lubricating, rollers and bearings
- Four fundamental forces: strong, electromagnetic, weak, and gravitational forces
- Gravity and gravitation—geocentric, heliocentric:
 - Laws of planetary motion:
 - Empirical, law of orbits
 - Mathematical description of law of areas
 - Aphelion, perihelion
 - Quantitative treatment of law of periods
 - Universal gravitation:
 - Kinematics, dynamics
 - Universal law of gravitation, Cavendish's measurement of G
- Earth's gravitational field:
 - Factors affecting g , static equilibrium, center of gravity
 - Stable, unstable, and neutral equilibrium, instability
 - Determining the CG, multiple suspensions, center of mass
 - Gravitational field, gravitational field strength

Physics cont.

► RED indicates NEW MATERIAL

Concurrent Forces

- Force as a vector:
 - Free-body diagram, principle of transmissibility, tension
 - Center of gravity, friction, translational equilibrium, equilibrant
- Force problems:
 - Friction, level surfaces, angled forces, inclined plane
 - Load-bearing structures

Circular & Periodic Motion

- Uniform circular motion:
 - Centripetal acceleration: rate of, centripetal force, centrifugal force, roadway and railway curves
- Periodic motion:
 - Motion of a spring:
 - Spring constant, equilibrium, oscillatory motion
 - Period, amplitude, frequency, simple harmonic motion
 - Motion of a pendulum: laws of a pendulum, physical pendulum
 - Resonance: natural frequency, resonance

Work & Machines

- Work:
 - Scientific definition, work and force, basic work equation
 - Units of work, scalar quantity
 - Applied at an angle
 - Concurrent applied forces
 - Negative work, net work, work and potential energy
- Power: watt, horsepower, defining work in terms of power
- Simple machines:
 - Lever:
 - Law of levers, fulcrum, load
 - Input force, output force, input distance, output distance
 - Input lever arm, output lever arm, input work, output work
 - Mechanical advantage, classes of levers
 - Inclined plane, wedge, and screw; pulley: block and tackle; wheel and axle
 - Efficiency

Energy & Momentum

- Energy:
 - Kinetic energy:
 - Kinetic energy equation, work and kinetic energy, relative contributions of mass and velocity
 - Potential energy:
 - Gravitational, elastic force
 - Conservative forces: nonconservative force, dissipative force
 - Conservation of energy:
 - Mechanical energy
 - Law of conservation of mechanical energy
 - Law of conservation of energy
- Momentum:
 - Original formulation of Newton's second law:
 - Two useful interpretations
 - Law of conservation of momentum
 - Colliding objects:
 - Elastic and inelastic collisions, elastic one-dimensional collisions
 - Completely inelastic one-dimensional collisions
- Impulse

Rotary Motion: Angular, Circular, & Rotary Motion

- Angular velocity and angular acceleration:
 - Arc length, rim speed, radians
 - Rotary motion:
 - Angular displacement, angular velocity, and angular acceleration
 - Basic equations for rotary motion, linear motion and angular motion
- Radian measure for circular motion
- Rotational inertia: experimental study of, equation for, I for various bodies
- Torque:
 - Law of torque: radius of a force
 - Work, power, kinetic energy, and momentum:
 - Total kinetic energy of moving body
 - Conservation of energy in rotary motion
 - Conservation of angular momentum
 - Flywheels
 - Angular momentum as a vector:
 - Right-hand rule
 - Gyroscope
- Parallel forces:
 - Effects of parallel forces on rotating body
 - Effects of static equilibrium: translational equilibrium, rotational equilibrium

Heat

- Thermometry:
 - Thermal equilibrium
 - Constructing a temperature scale:
 - Fahrenheit, Celsius, and Kelvin scales
 - Triple point, absolute scale
 - Converting among temperature scales
- Thermal expansion:
 - Effects of heating a solid: linear, area, and volume expansion
 - Liquid expansion
- Heat exchange:
 - Caloric theory
 - Units of heat
 - Law of heat exchange:
 - Heat capacity
 - Specific heat
 - Phase changes: melting, freezing, exothermic, heat of vaporization, condensation, calorimeter, calorimetry
 - Heat transfer:
 - Heat conduction, thermal conductor, thermal conductivity
 - Thermal insulator, heat flow
 - Conduction, convection, radiation

Laws of Thermodynamics

- First Law of Thermodynamics:
 - Internal energy:
 - System, surroundings
 - Closed system, open system, isolated system
 - Equilibrium, internal energy, thermal energy
 - Mechanical equivalent of heat
 - Thermodynamics
 - Internal energy equation
 - Qualitative explanation of adiabatic processes, isothermal

Physics cont.

► RED indicates NEW MATERIAL

Laws of Thermodynamics cont.

- Ideal gas law:
 - Reversible and irreversible processes
- Second Law of Thermodynamics:
 - Entropy:
 - Quantitative definition
 - Tendency to minimum energy and maximum entropy
 - Other formulations of the second law
 - Cause of ordered complexity
 - Evolution and the second law of thermodynamics: evolution's challenge to science
- Zeroth and Third Laws of Thermodynamics: thermal equilibrium

Waves

- Transverse waves:
 - Wave pulse, crest, trough
 - Elastic medium
 - Energy transport
 - Wave properties:
 - Simple harmonic motion, sinusoidal, periodic
 - Frequency, period, speed, wavelength, amplitude
 - Wave classification:
 - One-, two-, and three-dimensional waves
 - Interface, wavefront, ray; straight, spherical, and plane waves
- Longitudinal waves:
 - Compression pulse, rarefaction pulse, longitudinal waves
 - Sinusoidal character of longitudinal waves
 - Water waves, sound waves
- Boundary effects:
 - Reflection:
 - Angle of incidence, angle of reflection, law of reflection, reflection of sound, sonar
 - Refraction: of sound waves
 - Diffraction: of sound waves
- Superposition:
 - Composite wave trains
 - Constructive and destructive interference
 - Standing wave train, standing wave:
 - Node, antinode, loop, envelope of oscillation

Sound

- Nature of sound:
 - Graphical representation of sound waves:
 - Displacement and pressure wave trains
- Speed of sound:
 - Hardness
 - Density, temperature, effect of air temperature
- Doppler effect:
 - General Doppler equation
 - Sonic booms, supersonic speed, shock wave
- Characteristics of sound:
 - Intensity:
 - Threshold of hearing, quantitative treatment, amplifying
 - Loudness:
 - Nonlinear receiver, relative intensity, quantitative treatment
 - Decibel

- Pitch:
 - Sonic spectrum, mean free path, audio spectrum
- Infrasonic and ultrasonic waves
- Cavitation
- Ear's nonlinear response to frequency

Nature of Light

- Early light theories:
 - Ancient contributions, camera obscura, rectilinear propagation
 - Huygens' theory
 - Newton's theory:
 - Corpuscles
 - Young's demonstration, Herschel's discovery
 - Infrared rays
 - Maxwell's theory, electromagnetic waves, photons, wave-particle duality
- Electromagnetic spectrum:
 - Nature of an electromagnetic wave: range of wavelengths, electromagnetic spectrum, Planck's constant
 - Regions within the electromagnetic spectrum: visible light, infrared, ultraviolet
- Color:
 - Spectrum of visible light:
 - ROY G. BV
 - Solar spectrum
 - Monochromatic, composite light
 - Light mixing:
 - Additive mixing, primary colors
 - Secondary and complementary colors
 - Objects' colors:
 - Surface color
 - Transparent, translucent, opaque, color filters, hue, pure color, brightness
 - Pigment mixing:
 - Subtractive mixing, subtractive primaries
 - Subtractive secondaries

Reflection of Light

- Laws of reflection:
 - Absorbed, scattered, transmitted, reflected, reflectance, specular and diffuse reflection
 - First law of reflection
 - Second law of reflection
- Mirror images:
 - Plane mirrors: virtual and real images, right-angled mirror, double mirror
 - Concave mirrors:
 - Spherical mirrors, concave, convex
 - Vertex, center of curvature, principal axis
 - Secondary axis, radius of curvature, aperture, point source
 - Focal point, focal length, focal plane, ray diagram
 - Principal rays: central, parallel, and focal rays; real and virtual image
 - Convex mirrors: spherical aberration
 - Parabolic mirrors
- Mirror equation:
 - Establishing the mirror equation: geometric relationships, important sign conventions
 - Lateral magnification: comparing heights, important references

Physics cont.

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Refraction of Light

- Laws of refraction:
 - Optical density
 - Refraction
 - Refractive index, refractometer
 - First law of refraction: angle of incidence, angle of refraction
 - Second law of refraction: principle of reversibility
 - Refraction effects: mirage
 - Total internal reflection: critical angle
- Lenses:
 - Convex and concave lenses
 - Planar lenses, sign convention, focal length of lens
 - Converging lenses:
 - Principal axis, principal focal point, optical center, focal length
 - Secondary focal point, converging images, ray diagrams
 - Optical plane; parallel, central, and focal rays
 - Diverging lenses
 - Lensmaker equation
- Thin lens equation:
 - Lateral magnification: lens combinations, corrective lenses
 - Myopia, hyperopia, power of a lens

Wave Optics

- Interference:
 - In phase, out of phase, antinode, node
 - Newton's rings: fringes, cause of, optically flat
 - Interference fringes in soap film:
 - Monochromatic and color fringes
 - Iridescence
- Diffraction:
 - Obstacle diffraction: umbra, penumbra
 - Single-slit diffraction: diffraction fringes, antinode, node, fringe formation
 - Multiple-slit diffraction: double slits, coherent light, triple slits, zeroth-order maximum, first-order maximum, second-order maximum
 - Diffraction gratings:
 - Diffraction angle, grating constant, reflection grating, transmission grating, phase gratings
- Dispersion:
 - Dispersion of white light:
 - By a prism
 - By diffracting grating
 - Chromatic aberration
 - Rainbows:
 - Formation, primary bow, secondary bow
 - Supernumerary bows, miniature bows, lunar bow
- Polarization: unpolarized, polarized, by selective absorption, by reflection
- Scattering, structural colors

Electrostatics

- Charge:
 - Static electricity: discharge, law of electric charges, neutralized
 - Charge carriers:
 - Anion, cation
 - Current in gases, liquids, and solids
 - Conductors, delocalized electrons, insulators, semiconductors

- Transfer of charge: conduction, induction, grounded, electroscope
- Coulomb's law:
 - Law of electric force, coulomb
 - Microcoulombs, permittivity
 - Comparing gravitation and electric force, charge conservation
- Electric fields:
 - Electric field strength: first formulation, second formulation
 - Electric field maps:
 - Lines of force
 - Uniform field
- Electric potential:
 - Electric potential energy vs. electric potential
 - Potential difference
 - Potential gradient: GPE, EPE
 - Distribution of free electrons: corona discharge, equipotential surface, equipotential lines

Magnetism

- Magnetic materials:
 - Dipolarity: magnetite, lodestone, north pole, south pole, dipolar, monopoles, law of magnetic poles
 - Making magnets:
 - Magnetization, contact, induction, demagnetization, keeper, temporary vs. permanent magnets
 - Permalloy, alnico
- Coulomb's law of magnetic force
- Magnetic fields:
 - Mapping a magnetic field, lines of flux
 - Magnetic induction
 - Permeability
- Magnetic moment:
 - Spin magnet, orbital magnets, domain theory
 - Saturation
 - Diamagnetic, paramagnetic, ferromagnetic
- Electromagnets:
 - Conventional current
 - Oersted's discovery
 - Ampere's right-hand rule
 - Solenoid
- Magnetic force: two loops or two solenoids, two parallel conductors, ampere, coulomb, force of a straight conductor
- Defining magnetic induction:
 - Direction of magnetic force: three-finger rules
 - Force on a moving charge
 - Magnetic flux: flux density

Current Generation

- Electromagnetic induction:
 - Current in a moving conducting loop:
 - Right-handed three-finger rule, magnetic flux
 - Electromagnetic induction
 - Different motions in a magnetic field
 - Galvanometer
 - Discovery of electromagnetic induction:
 - Law of induction
 - Lenz's law: direction of current

Physics cont.

► RED indicates NEW MATERIAL

Current Generation cont.

- Electric generators:
 - Simple AC generators: armature, slip rings, brushes, alternating current, AC frequency
 - Simple DC generators: direct current, commutator
 - Complex generators: rotor, stator, prime mover, three-phase current
- Motors:
 - Motor effect: electric motor, torque, torque arm, two-pole motor
 - Energy losses: hysteresis, eddy currents
- Electrochemical cells:
 - Current production: electrodes, electrolyte, salt bridge, load, anode, cathode, electromotive force
 - Batteries: cells in series and in parallel
- Thermoelectricity:
 - Seebeck effect: thermocouple, Seebeck voltage and effect
 - Peltier effect
- Piezoelectricity:
 - Piezoelectric effect and devices

Electric Circuits

- Resistance:
 - Defining resistance
 - Resistance in a conductor
 - Ohmic, nonohmic, resistivity
 - Rheostat
 - Nichrome
 - Insulators, semiconductor, conductor, superconductivity
- Ohm's Law:
 - Elements of a circuit: current source, conventional current
 - Circuits with a single resistance: Ohm's law
 - IR drop: voltage, energy transactions
 - Quantitative treatment of equivalent resistance:
 - Series and parallel resistors
 - Rules for resistances in series
 - Equivalent parallel resistance, rules for resistance in parallel
- Complex circuits:
 - Networks
 - Circuit resistance and current:
 - Open circuit
 - Open-circuit voltage
 - Closed circuit
 - Closed-circuit voltage
 - Short circuit
 - Measuring electricity: multimeter, galvanometer, ammeter, voltmeter, ohmmeter
 - Kirchhoff's Laws: first law, junctions, principle of charge conservation, second law

Electrical Devices

- Electrical work:
 - Work and heat:
 - Calculation of joule heat
 - Work and power:
 - Three equations for electric power
 - Energy consumption

- Effective values of current and voltage: house current, in phase
- Capacitor:
 - Calculating capacitance: farad, dielectric, dielectric constant, permittivity of free space, dielectric strength
 - Capacitor combinations: parallel and series capacitors
- Inductance: single loop, self-induced emf, coil, self-inductance, inductor, mutual inductance
- Inductor combinations: series and parallel inductors, series-aiding and series-opposing combinations
- Transformers:
 - Transformer equation
 - Step-up and step-down transformers
 - Efficiency

Advanced Physics Concepts

- Quantum theory:
 - Blackbody radiation:
 - Incandescence
 - Radiance
 - Stefan-Boltzmann law, Wien's law
 - Quanta: Planck, quantum theory
- Photons:
 - Photoelectric effect:
 - Photoelectrons, work function
 - Saturation potential, stopping potential
 - Threshold frequency, Einstein's hypothesis, Compton effect
- Matter waves:
 - Momentum of light
 - De Broglie's equation, matter waves
 - Wave-particle duality, complementarity
- Quantum numbers:
 - Pauli exclusion principle, orbital
 - Principal, subshell, magnetic, and spin quantum numbers
 - Angular momentum
- Spectral lines:
 - Line emission spectra:
 - Line absorption spectrum, emission spectra and classical theory, quantized, ground and excited states
 - Quantitative relationships between wavelength, energy, and quantum numbers
 - Wave mechanics:
 - Wave mechanical model, wave function
 - Uncertainty principle:
 - Mathematical formulation, philosophical implications

Relativity

- Speed of light:
 - Galileo's, Rømer's, and Michelson's methods; ether, interferometer
- Theories of relativity:
 - Physical absolutes, relativism:
 - Special relativity:
 - Five applications, rest mass, time dilation, length contraction
 - Quantitative aspects
 - General relativity: its effects, conclusion