Curriculum Outline: Eighth Grade

Sally Kirkpatrick

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Overview

Teaching eighth-graders is a wonderful opportunity for any teacher. At first blush, teachers always groan at the mention of eighth-graders, because thirteen- and fourteen-year-olds are difficult at times, but I have found they are a delightful, enthusiastic age group. The best part of teaching science to eighth-graders is their freshness. Like first-graders who must be taught to cut before they can make paper dolls, eighth-graders must be taught the basics of "real" science. This is an opportunity to inspire them and excite them; to teach them proper lab technique and data analysis, some of which they have not really had before. The most successful teachers pay attention to detail; they encourage and push while holding the students to standards which could inspire them to pursue a career in the sciences; they offer enticing scientific principles and enlightening laboratory processes; and lastly, they make science fun!

Eighth Grade Science Unit Outlines

Unit 1: Matter and Energy

1. Properties of solids, liquids, gases (review)
    a. Definitions:
        1) Viscosity
        2) Surface tension
            a) Water – introduction to special properties of water that affect scientific principles learned in grade 8
        3) Vapor
2. Energy
    a. Kinetic and potential energy (review)
    b. Work; formula: work = force x distance
        1) Force measured in newtons (N or $kg \bullet m/s^2$)
    c. Motion of molecules
    d. Collisions of molecules
3. Thermal energy
    a. Causes expansion of molecules
        1) Increases in thermal energy
            a) Thermometers
            b) Temperature scales
                1. Conversions
    b. Changes in thermal energy
        1) Temperature
        2) Thermal equilibrium
4. Heat
    a. Molecular movements
    b. Heat flow
        1) Transfer of heat (introduction)
            a) Conduction
                1. Molecular collisions transfer heat
            b) Convection
            c) Radiation
    c. Specific heat
        1) Heat gain and loss
        2) Unit
        3) Relationship to work (4.2 joules)
5. Changing states (review)
    a. Melting and freezing point
        1) Adding substances, like salt, can change points
        2) Changing pressure can change points
    b. Vaporization
    c. Evaporation

- d. Condensation

6. Behavior of fluids
    - a. Fluid definition
    - b. Balanced pressure
        - 1) Force and pressure
        - 2) Units
        - 3) Relationship of temperature and volume
    - c. Atmospheric pressure
    - d. Buoyant force
        - 1) Displacement
            - a) Used to find volume of an irregular object
        - 2) Archimedes' principle
    - e. Density
    - f. Fluid

Unit 2: Scientific Process Skills

1. Steps of the scientific method
    a. Identify a problem, research information, form a hypothesis, set up experiment, analyze data, draw conclusions, communicate results
2. Experimenting
    a. Hypothesis
    b. Variables – dependent, independent
    c. Constants and controls
3. Data
    a. Collecting data
        1) Observations
            a) Qualitative observations
            b) Quantitative observations
        2) Using instruments
            a) Measuring in SI
                1. Length, mass, weight, volume, density
            b) Accuracy
                2. Estimating, rounding, significant digits
            c) Precision
                3. Instrument selection, repeated readings, human error, averaging multiple readings, percent error
    b. Recording data
        1) Data table
            a) For qualitative observations
            b) For quantitative observations
        2) Orderly and logical
        3) Neatly record mathematical computations
4. Results
    a. Analyze the data
    b. Using charts and graphs
5. Drawing conclusions
    a. Restate hypothesis
    b. Support interpretations from analyzed data
6. Laboratory skills
    a. Laboratory safety – symbols and rules
    b. Experimental techniques
7. Technology – using instruments to measure; proper units for each
    a. Metric ruler
    b. Graduated cylinder
        1) Meniscus – read the bottom of the dip
        2) Displacement
    c. Triple-beam balance

    d. Spring scale
    e. Thermometer
8. Using values and units
    a. Density
    b. Weight
    c. Dimensional analysis
9. Extrapolating
    a. Predictions, patterns, and probability
10. Communicate valid results
11. Scientific models
    a. Limitation of models
12. Theories and laws

Unit 3: Chemistry

1. Atoms
    a. Atomic structure and properties
        1) Building blocks of matter
        2) Subatomic particles (protons, neutrons, and electrons)
            a) Nucleus
                1. Atomic number
                2. Atomic mass number
            b) Electron cloud
    b. Using the Bohr model
        1) Electron configuration
        2) Valence electrons
            a) Oxidation numbers
    c. Changes in the subatomic particles
        1) Ions
            a) Ionic and covalent bonds (introduction)
                1. Octet rule
        2) Isotopes
        3) Radioactive decay
            a) Transmutation
            b) Half-life
2. Periodic table
    a. Arranged by atomic number
        1) Periods
        2) Groups, families
    b. Zones
    c. Metals
    d. Nonmetals
    e. Metalloids
3. Reading the periodic table
    a. Element keys
    b. Symbols
        1) Locate and recognize on periodic table
    c. Atomic numbers
    d. Atomic mass numbers
    e. Properties and trends of the periodic table
        1) Specific heat
        2) Losing and gaining electrons in metals and nonmetals
            a) Oxidation numbers
4. Families on the periodic table – properties and descriptions
    a. Alkali metals
    b. Alkaline earth metals

c. Boron family
d. Carbon group
e. Nitrogen group
f. Oxygen family
g. Halogens
h. Noble gases
i. Transition elements
j. Inner transition elements

5. Chemical reactions
    a. Chemical and physical change
        1) Chemical reactions
            a) Indicators
    b. Chemical equations
        1) Nomenclature
            a) Symbols
            b) Subscripts
            c) Coefficients
            d) Counting atoms and elements
            e) Writing and naming compounds
                1. Common polyatomic ions
    c. Chemical equations take the form:
        1) Reactants [→ produces (yields)] products
            a) Reactants
            b) Products
            c) Arrow is read as *produces* or *yields*
            d) The information in a chemical equation can indicate physical states and proportions of substances
    d. Law of conservation of mass
    e. Determining if chemical equations are balanced
        1) Balancing simple equations
6. Energy in chemical reactions
    a. Law of conservation of energy
    b. Chemical energy may be absorbed/released when bonds break
    c. Rate of heat release
    d. Heat absorbed
        1) Symbol Δ
7. Rates of chemical reactions
    a. Activation energy
    b. Reaction rates
        1) Changes in reaction rates
        2) Changing temperature
        3) Changing concentrations

4) Surface area
5) Inhibitor
6) Catalyst
    a) Enzymes

Unit 4: Force and Motion

1. Motion
    a. Speed
        1) Speed = distance divided by time
        2) Units: m/s; km/hr
    b. Velocity
        1) Displacement is direction and distance
        2) Velocity = displacement divided by time
    c. Acceleration
        1) Change in velocity divided by the time required for the change
        2) Acceleration = final speed minus initial speed divided by time
        3) Due to gravity = $9.8 m/s^2$
        4) Acceleration = force divided by mass
        5) Turning
        6) Units: m/s^2
2. Kinetic and potential energy
3. Force
    a. Contact forces
    b. Long-range forces
    c. Newton's first law of motion
        1) Inertia
        2) Inertia and mass
            a) Momentum
                1. Momentum = mass times velocity
                2. Units: kg•m/s
    d. Adding forces
        1) Balanced forces
        2) Unbalanced forces
        3) Net forces
4. Newton's second law of motion
    a. Formula (a = F/m; F = ma)
    b. Unbalanced forces and motion
    c. Gravity
        1) Force of gravity = $9.8 m/s^2$
    d. Mass and weight
        1) Weight = mass times acceleration due to gravity ($9.8 m/s^2$)
        2) Unit: kg•m/s^2 or newton
    e. Friction
5. Newton's third law of motion
    a. Action and reaction
    b. Using formula (a = F/m; F = ma)
        1) Unit: kg•m/s^2 or newton

Unit 5: Geology

1. Rock cycle
    a. Processes that change rocks
    b. Uniformitarianism
2. Igneous rocks
    a. Intrusive and extrusive igneous rocks
    b. Igneous rock processes
        1) Melting and cooling
            a) Crystal size and cooling rates
        2) Magmas and lavas
            a) Basaltic, andesitic, and granitic
            b) Volcanoes (review)
        3) Common igneous rocks – granite, basalt
3. Metamorphic rocks
    a. Foliated and non-foliated
    b. Metamorphic rock processes
        1) Heat and pressure
        2) Contact and regional metamorphism
        3) Forming common metamorphic rocks: shale-slate, basalt-schist, granite-gneiss, limestone-marble, sandstone-quartzite
4. Sedimentary rocks
    a. Detrital, chemical, and organic
    b. Sedimentary rock processes
        1) Weathering, erosion, deposition, compaction, and cementation
        2) Common sedimentary rocks: shale, limestone, sandstone
    c. Principle of superposition
        1) Relative age – index fossils, matching layers, unconformities
        2) Absolute age – radioactive decay
5. Continental drift and plate tectonics
    a. Pangaea
    b. Sea-floor spreading
6. Plate tectonics
    a. Layers of Earth
        1) Lithosphere, asthenosphere
    b. Types of boundaries, land features, and movements at plates
        1) Divergent
            a) Tension forces
            b) Normal faults
            c) Fault-block mountains, rift valleys, mid-ocean ridge, volcanoes
            d) What types of rocks are formed in this area
        2) Convergent

a) Compression forces
b) Reverse faults
c) Continental-continental features: fault-block mountains, thrust-fault mountains, folded mountains, earthquakes
d) Continental-oceanic and oceanic-oceanic features: fault-block mountains, subduction zones, island arcs, trenches, black smokers, volcanoes, deep-focus earthquakes
e) What types of rocks are formed in these areas

3) Transform
a) Shearing forces
b) Lateral faults
c) What types of rocks are formed in this area

7. Earthquakes
a. Unbalanced forces
1) Strain
2) Elastic limit of a rock
3) Elastic rebound
b. Focus and epicenter
c. Faults
d. Seismic movements and vibrations
e. Ring of Fire

8. Crust, mantle, outer core, and inner core
a. Heat movement in the mantle
1) Plasticity
2) Convection currents

Unit 6: Waves

1. Waves
    a. Waves – rhythmic disturbances caused by vibrations which carry energy, not matter
        1) Mechanical waves – molecules in media transfer energy
            a) Transverse waves
                1. Particles move at right angles
                2. Crest, trough
            b) Compressional (longitudinal) waves
                1. Particles move back and forth
                2. Compression, rarefaction
2. Characteristics of waves:
    a. Amplitude
        1) Energy of waves
            a) Brighter, louder, larger, stronger
    b. Wavelength (λ)
    c. Frequency (f)
        1) Hertz (Hz)
    d. Speed (υ)
        1) Formula: $\upsilon = f \times \lambda$
        2) Relationship of frequency and wavelength
            a) Color and pitch
        3) Constant in same media for given density
3. Earthquake waves:
    a. Seismic waves – relative speed, particle motion, movement through solids and liquids, and damage
        1) Primary waves, secondary waves, surface waves
    b. "Seeing" Earth's interior using waves
    c. Tsunamis
4. Water waves
    a. Transverse waves – crest, trough, amplitude, wavelength, wave height
    b. Wave motion – how particles of water move in a wave
    c. Effect of friction from wind on water
        1) Length of time wind blows, distance over which wind blows (fetch), speed of wind
    d. Breakers
        1) How they are formed, move, and break
        2) Beach erosion
5. Tides
    a. Gravitational force of the sun, earth, and moon
    b. Tidal range – high and low tides
    c. Earth, moon, Sun's effect on tides

1) Spring tide; neap tide

6. Moon phases
    a. Waxing, waning
    b. New moon, crescent, quarter, gibbous, full moon
7. Electromagnetic waves
    a. Transverse waves that do not require matter to carry energy
    b. Electromagnetic spectrum
8. Stars
    a. Constellations
    b. Properties of stars
        1) Spectrum
        2) The sun (fusion, layers, atmosphere, features)
    c. Hertzsprung-Russell (H-R) diagram
    d. Life cycle
        1) Nebulae, main-sequence star, red giant, white dwarf, supergiant, supernova, black hole, neutron star
        2) Formation of elements by fusion in stars
9. Galaxies and the universe
    a. Types of galaxies
    b. Expansion and size of universe (light-year)

Unit 7: Heat Transfer

1. Atmosphere
    a. Heat balance between Earth and space
    b. Atmospheric layers: troposphere, stratosphere
    c. Pressure
2. Heat
    a. Sun is source of most energy on Earth – rays are reflected or absorbed
    b. Movement of heat
        1) Radiation
        2) Conduction
        3) Convection – movement of heat in a fluid
3. Forming wind
    a. Uneven heating of the curved surface of the Earth
        1) Low-pressure and high-pressure systems
    b. Coriolis effect
    c. Global winds
        1) Equatorial doldrums, trade winds, horse latitudes, westerlies, polar easterlies
        2) Jet streams
    d. Land breeze and sea breeze
        1) Differences in specific heats of land and water
4. Weather – measured conditions of atmosphere for a certain time and place
    a. Air pressure – barometer
    b. Winds – anemometer, wind vanes and socks
    c. Air temperature – thermometer
    d. Relative humidity – wet/dry bulb hygrometer, sling psychrometer
    e. Clouds – formation, types – use a cloud chart to determine cloud types
    f. Precipitation – rain gauge
5. Weather patterns
    a. Air masses
        1) Maritime polar, maritime tropical, continental polar, continental, tropical
    b. Fronts
        1) Warm front
        2) Cold front
            a) Thunderstorms
    c. Hurricanes
6. Ocean currents
    a. Surface currents
        1) Formed by global winds; spread heat around Earth (Gulf Stream)
    b. Density currents

1) Created by differences in salinity, temperature, and turbidity
a) Methods of formation – Mediterranean Sea
2) Form slow-moving, deepwater currents
a) Temperature of coldest water
b) Important currents (North Atlantic Deep Water, Antarctic Bottom Water, Antarctic Intermediate Water)
c) Upwelling – nutrient- and oxygen-rich water
3) El Niño (brief description)

7. Ocean currents and weather systems
a. Air takes on the temperature of the water
1) Gulf Stream, California Current

Unit 8: Ecology

1. Ecosystems
    a. Chemicals cycle through the ecosystem
        1) Inorganic substances
            a) Minerals, vitamins
            b) Water
                1. Cells (introduction and review)
                    a. Diffusion and osmosis
                        1) Equilibrium
        2) Organic compounds
            a) Proteins
                1. Enzymes
            b) Lipids
            c) Carbohydrates
            d) Glucose
    b. Producers
        1) Photosynthesis
            a) Light-dependent phase
                1. Sunlight strikes chlorophyll, releasing electrons, which undergo a series of chemical reactions involving ATP, adenosine triphosphate
                2. Then, electrons split two water molecules releasing oxygen atoms and hydrogen ions
                3. Gas exchange – oxygen and carbon dioxide
                    a. Stoma
                        1) Description, function
                            a) Guard cells
                        2) Turgor pressure
                    b. Water vapor and oxygen are by-products
            b) Light-independent phase (dark phase)
                1. Hydrogen ions from light phase and carbon dioxide from the stoma combine during the Calvin cycle, a complicated series of chemical reactions needed to form glucose, a simple sugar
                    a. Glucose, energy
                        1) Storage
    c. Consumers
        1) Body organization (cells, tissues, organs, organ systems)
            a) Systems interaction
                1. Circulatory, respiratory, digestive
                    a. Digestion of food – villi
                    b. Oxygen to cells – alveoli

2. Cellular respiration
a. Mitochondria
1) Oxygen
2) Glucose (glycolysis)
3) The complex series of chemical reactions that take place in the mitochondria is called the citric acid cycle or Krebs cycle
4) ATP used for energy by the cell
5) By-products: CO_2, water vapor
3. Waste removal
a. Kidneys
1) Nephrons
b) Feedback
1. Negative feedback – homeostasis
a. Overheating, blood pressure
b. Regulating glucose
1) Glucose must be available for use by mitochondria
2) Insulin, glucagons, glycogen
2. Positive feedback
a. Uterus contraction, blood clotting
2) Feeding
a) Herbivores
b) Carnivores
1. Predators/prey
c) Omnivores
d) Scavengers
d. Decomposers
e. Relationships
1) Mutualism
2. Food chains
3. Populations
a. Population limits
4. Soils
a. Fertile soils
1) Humus
2) Soil profile (review)
b. Infertile soils
1) Leaching
2) Runoff
3) Desertification

- c. Nitrogen cycle
    - 1) Legumes
        - a) Nitrogen-fixing
    - 2) Proteins

5. Land – people's effects
    - a. Direct – waste disposal, mining, development, deforestation, habitat destruction
    - b. Indirect – nonnative invasive species
        - 1) Reasons for introduction
        - 2) Effects on habitat
    - c. Protecting native ecosystems
        - 1) Imbalance in an ecosystem
        - 2) Natural preserves and biodiversity
    - d. Extinctions caused by people
6. Land use – agriculture
    - a. Soil depletion – repeated crop planting, nutrient-intensive crops
    - b. Increase fertility – crop rotation, fallow fields
    - c. Farming methods to reduce erosion – contour farming, strip farming, windbreaks, terracing
    - d. Adding chemicals for increased crop yields (fertilizers, pesticides, etc.)
7. Water
    - a. Hydrosphere
    - b. Water cycle
        - 1) Evaporation
            - a) Transpiration
            - b) Perspiration
        - 2) Condensation
        - 3) Precipitation
            - a) Acid rain
            - b) Runoff
                1. Things that affect runoff
        - 4) Watershed
    - c. Water pollution
        - 1) Concentrating chemical runoff affects life
            - a) Point source and nonpoint source pollution
            - b) Pesticides, fertilizers – hypoxic zone
        - 2) Sediment
        - 3) Sewage
        - 4) Other sources: metals, plastics, oil and gasoline, heat
        - 5) Reducing water pollution
8. Air
    - a. Air pollution

1) Natural
2) Man-made
    a) Smog, photochemical smog
    b) Air pollution – a worldwide concern
    c) Acid rain
3) CFCs and the ozone layer
4) Carbon dioxide cycle
    a) Greenhouse effect
    b) Modifying CO_2 levels
5) Air pollution and health
6) Reducing air pollution

Unit 9: Natural Extinctions and Genetics

1. Natural extinctions
    a. Geologic time – major subdivisions
    b. Organic evolution
        1) Species
        2) Survival and the environment
            a) Nonliving influences – rainfall, elevation, etc.
            b) Interactions of species – predation, competition, etc.
        3) Natural selection
            a) Evolution
            b) Mutation
        4) Selective breeding
        5) Direction of evolution
            a) Adaptive radiation
        6) The evolution of a new species
            a) Trilobites
        7) Extinction of a species
    c. Earth history
        1) Natural extinctions
        2) Mass extinctions
            a) Permian extinction
            b) K-T boundary
                1. Dinosaurs
        3) Major events in geologic time
2. Genetics
    a. Traits
    b. Genotypes
        1) DNA
            a) Double helix
            b) Nucleotides
                1. Base pairs
                2. Deoxyribose – sugar
                3. Phosphate backbone
        2) Genetic material located in nucleus of cell
            a) Chromosomes
            b) Genes
    c. Phenotypes – genetic material and environment
        1) External influences
            a) Sunlight, water, vitamins, minerals, food, temperature, competition
        2) Internal influences
            a) Hormones

d. Heredity
    1) Genetics
        a) Mendel
e. Dominant and recessive traits
    1) Alleles
        a) Homozygous, heterozygous
    2) Mendel's three principles of heredity
        a) Principle of dominance
        b) Principle of segregation
        c) Law of independent assortment
    3) Punnett squares
        a) Ratios, probabilities
            1. Genotypic, phenotypic
        b) Monohybrid, dihybrid crosses

Sally Kirkpatrick began teaching eighth grade in 1986 at Hubbard Middle School, Tyler, Texas. She has been active all her career in writing curriculum for the Tyler school district. In 1990, and again in 2005, she wrote the curriculum guide for grade 8 science. In 1999, she won the Gulf Coast Association of Geological Societies' Award for Excellence in the Teaching of Natural Resources in the Earth Sciences.