Appendices

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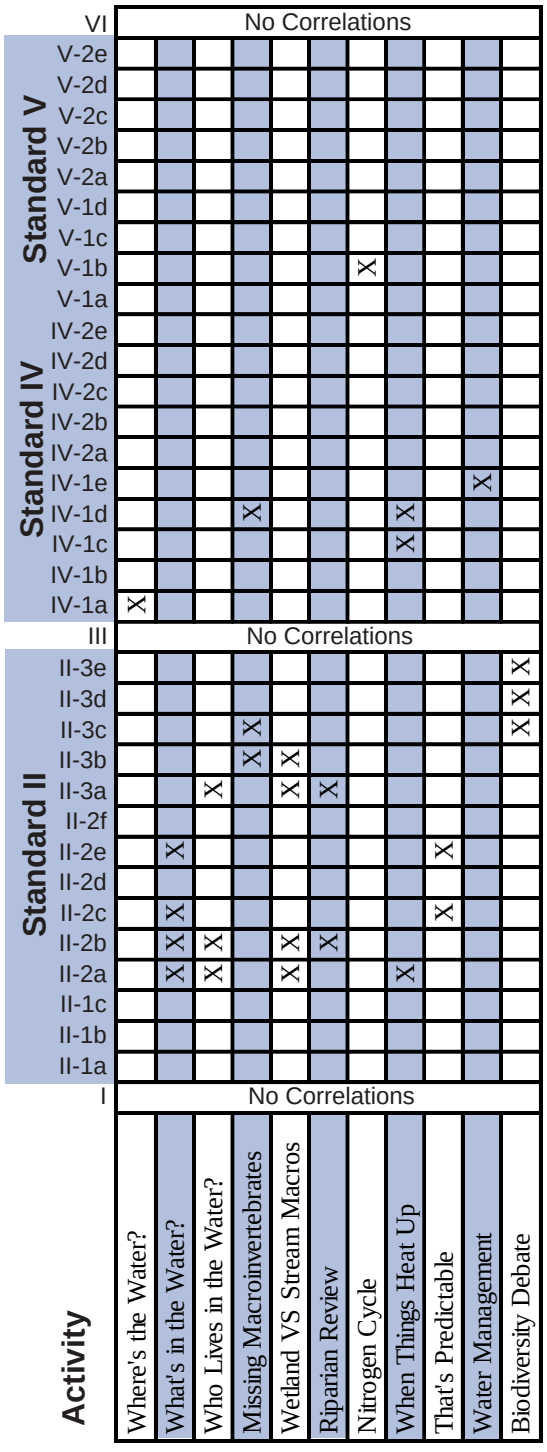
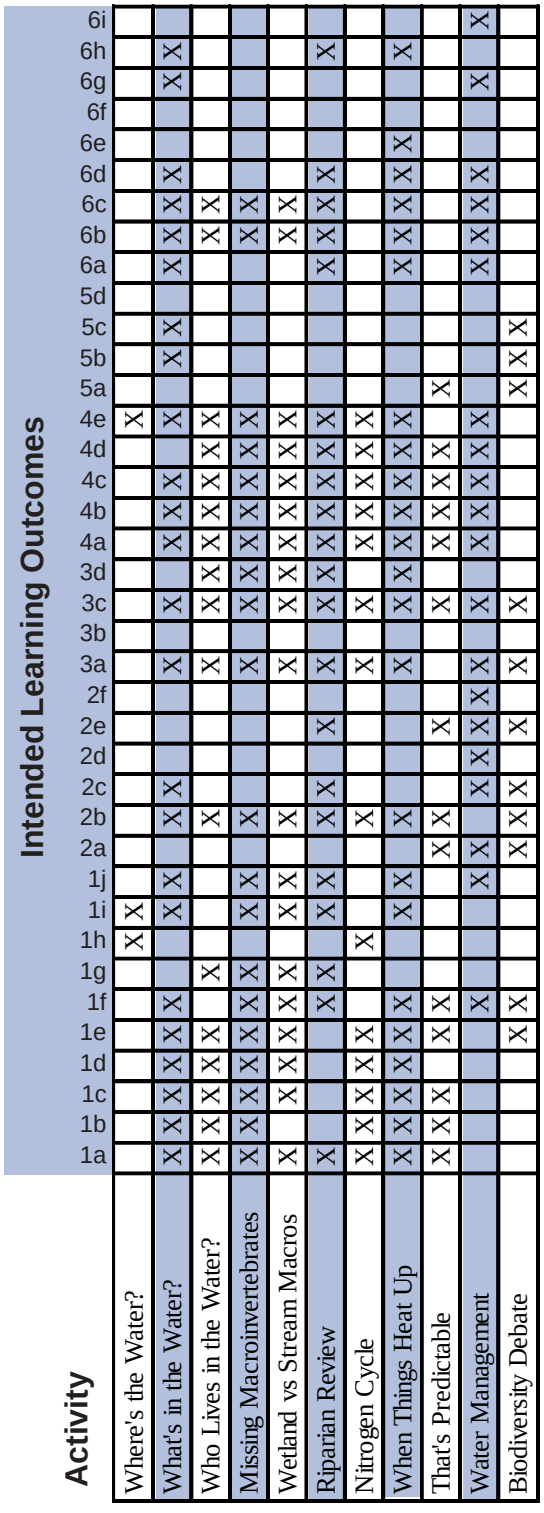
Appendix A

Curriculum Connections for 9th Grade Earth Systems Science





Appendix B

Intended Learning Outcomes for Earth Systems Science

(Developed by the Utah State Office of Education)

The Intended Learning Outcomes (ILOs) describe the skills and attitudes students should learn as a result of science instruction. They are an essential part of the Science Core Curriculum and provide teachers with a standard for evaluation of student learning in science. Instruction should include significant science experiences that lead to student understanding using the ILOs.

The main intent of science instruction in Utah is that students will value and use science as a process of obtaining knowledge based upon observable evidence.
By the end of science instruction in high school, students will be able to:

1. Use Science Process and Thinking Skills

a. Observe objects, events and patterns and record both qualitative and quantitative information.
b. Use comparisons to help understand observations and phenomena.
c. Evaluate, sort, and sequence data according to given criteria.
d. Select and use appropriate technological instruments to collect and analyze data.
e. Plan and conduct experiments in which students may:
- Identify a problem.
- Formulate research questions and hypotheses.
- Predict results of investigations based upon prior data.
- Identify variables and describe the relationships between them.
- Plan procedures to control independent variables.
- Collect data on the dependent variable(s).
- Select the appropriate format (e.g., graph, chart, diagram) and use it to summarize the data obtained.
- Analyze data, check it for accuracy and construct reasonable conclusions.
- Prepare written and oral reports of investigations.

f. Distinguish between factual statements and inferences.
g. Develop and use classification systems.
h. Construct models, simulations and metaphors to describe and explain natural phenomena.
i. Use mathematics as a precise method for showing relationships.
j. Form alternative hypotheses to explain a problem.

2. Manifest Scientific Attitudes and Interests

a. Voluntarily read and study books and other materials about science.
b. Raise questions about objects, events and processes that can be answered through scientific investigation.

c. Maintain an open and questioning mind toward ideas and alternative points of view.
d. Accept responsibility for actively helping to resolve social, ethical and ecological problems related to science and technology.
e. Evaluate scientifically related claims against available evidence.
f. Reject pseudoscience as a source of scientific knowledge.

3. Demonstrate Understanding of Science Concepts, Principles and Systems

a. Know and explain science information specified for the subject being studied.
b. Distinguish between examples and non examples of concepts that have been taught.
c. Apply principles and concepts of science to explain various phenomena.
d. Solve problems by applying science principles and procedures.

4. Communicate Effectively Using Science Language and Reasoning

a. Provide relevant data to support their inferences and conclusions.
b. Use precise scientific language in oral and written communication.
c. Use proper English in oral and written reports.
d. Use reference sources to obtain information and cite the sources.
e. Use mathematical language and reasoning to communicate information.

5. Demonstrate Awareness of Social and Historical Aspects of Science

a. Cite examples of how science affects human life.
b. Give instances of how technological advances have influenced the progress of science and how science has influenced advances in technology.
c. Understand the cumulative nature of scientific knowledge.
d. Recognize contributions to science knowledge that have been made by both women and men.

6. Demonstrate Understanding of the Nature of Science

a. Science is a way of knowing that is used by many people, not just scientists.
b. Understand that science investigations use a variety of methods and do not always use the same set of procedures; understand that there is not just one “scientific method.”
c. Science findings are based upon evidence.
d. Understand that science conclusions are tentative and therefore never final. Understandings based upon these conclusions are subject to revision in light of new evidence.
e. Understand that scientific conclusions are based on the assumption that natural laws operate today as they did in the past and that they will continue to do so in the future.
f. Understand the use of the term “theory” in science, and that the scientific community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this

new evidence.
g. Understand that various disciplines of science are interrelated and share common rules of evidence to explain phenomena in the natural world.
h. Understand that scientific inquiry is characterized by a common set of values that include logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results and honest and ethical reporting of findings. These values function as criteria in distinguishing between science and non-science.
i. Understand that science and technology may raise ethical issues for which science, by itself, does not provide solutions.

Science language students should use:
generalize, conclude, hypothesis, theory, variable, measure, evidence, data, inference, infer, compare, predict, interpret, analyze, relate, calculate, observe, describe, classify, technology, experiment, investigation, tentative, assumption, ethical, replicability, precision, skeptical, methods of science

Appendix C

Earth Systems Core Curriculum

(Developed by the Utah State Office of Education)

STANDARD I: Students will understand the scientific evidence that supports theories that explain how the universe and solar system developed.

Objective 1
Describe the big bang theory and evidence supporting it.

a. Determine the motion of a star relative to Earth based on a red or blue shift in the wavelength of light from the star.
b. Explain how evidence of red and blue shifts is used to determine whether the universe
is expanding or contracting.
c. Describe the big bang theory and the red shift evidence that supports this theory.
d. Investigate and report how science has changed the accepted ideas regarding the nature
of the universe throughout history.
e. Provide an example of how technology has helped scientists investigate the universe.

Objective 2
Relate the structure and composition of the solar system to the processes that exist in the universe.

a. Compare the elements formed in the big bang (hydrogen, helium) with elements formed through nuclear fusion in stars.
b. Relate the life cycle of stars of various masses to the relative mass of elements produced.
c. Explain the origin of the heavy elements on Earth (i.e., heavy elements were formed by fusion in ancient stars).
d. Present evidence that the process that formed Earth's heavy elements continues in stars today.
e. Compare the life cycle of the sun to the life cycle of other stars.
f. Relate the structure of the solar system to the forces acting upon it.

Science language students should use:
big bang theory, blue shift, heavy element, mass, nuclear fusion, red shift, theory, universe, astronomy

STANDARD II: Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.

Objective 1
Describe the unique physical features of Earth's environment that make life on Earth possible.

a. Compare Earth's atmosphere, solar energy, and water to those of other planets and moons in the solar system.
b. Compare the conditions that currently support life on Earth to the conditions that exist on other planets in the solar system.
c. Evaluate evidence for existence of life in other star systems, planets, or moons, either now or in the past.

Objective 2
Analyze how ecosystems differ from each other due to abiotic and biotic factors.

a. Observe and list abiotic factors (e.g., temperature, water, nutrients, sunlight, pH, topography) in specific ecosystems.
b. Observe and list biotic factors (e.g., plants, animals, organic matter) that affect a specific ecosystem (e.g., wetlands, deserts, aquatic).
c. Predict how an ecosystem will change as a result of major changes in an abiotic and/or biotic factor.
d. Explain that energy enters the vast majority of Earth's ecosystems through photosynthesis, and compare the path of energy through two different ecosystems.
e. Analyze interactions within an ecosystem (e.g., water temperature and fish species, weathering and water pH).
f. Plan and conduct an experiment to investigate how abiotic factors influence organisms and how organisms influence the physical environment.

Objective 3
Examine Earth's diversity of life as it changes over time.

a. Observe and chart the diversity in a specific area.
b. Compare the diversity of life in various biomes specific to number of species, biomass, and type of organisms.
c. Explain factors that contribute to the extinction of a species.
d. Compare evidence supporting various theories that explain the causes of large-scale extinctions in the past with factors causing the loss of species today.
e. Evaluate the biological, aesthetic, ethical, social, or economic arguments with regard to maintaining biodiversity.

Science language students should use:
abiotic, atmosphere, biodiversity, biome, biotic, ecosystem, extinction, system, aesthetic,

ethical, social, economic, stellar, photosynthesis, biomass, species

STANDARD III: Students will understand that gravity, density, and convection move Earth's plates and this movement causes the plates to impact other Earth systems.

Objective 1

Explain the evidence that supports the theory of plate tectonics.

a. Define and describe the location of the major plates and plate boundaries.
b. Compare the movement and results of movement along convergent, divergent, and transform plate boundaries.
c. Relate the location of earthquakes and volcanoes to plate boundaries.
d. Explain Alfred Wegener's continental drift hypothesis, his evidence, and why it was not accepted in his time.
e. Evaluate the evidence for the current theory of plate tectonics.

Objective 2

Describe the processes within Earth that result in plate motion and relate it to changes in other Earth systems.

a. Identify the energy sources that cause material to move within Earth.
b. Model the movement of materials within Earth.
c. Model the movement and interaction of plates.
d. Relate the movement and interaction of plates to volcanic eruptions, mountain building, and climate changes.
e. Predict the effects of plate movement on other Earth systems (e.g., volcanic eruptions affect weather, mountain building diverts waterways, uplift changes elevation that alters plant and animal diversity, upwelling from ocean vents results in changes in biomass).

Science language students should use:

plate tectonics, convergent, divergent, transform, plate, convection current, hypothesis, theory, seafloor spreading, biomes, climate, weather, geosphere, biosphere, hydrosphere, volcanic eruption, hot spot, fault

STANDARD IV: Students will understand that water cycles through and between reservoirs in the hydrosphere and affects the other spheres of the Earth system.

Objective 1

Explain the water cycle in terms of its reservoirs, the movement between reservoirs, and the energy to move water. Evaluate the importance of freshwater to the biosphere.

a. Identify the reservoirs of Earth's water cycle (e.g., ocean, ice caps/glaciers, atmosphere, lakes, rivers, biosphere, groundwater) locally and globally, and graph or chart relative amounts in global reservoirs.

b. Illustrate the movement of water on Earth and describe how the processes that move water (e.g., evaporation of water, melting of ice/snow, ocean currents, movement of water vapor by wind) use energy from the sun.

c. Relate the physical and chemical properties of water to a water pollution issue.

d. Make inferences about the quality and/or quantity of freshwater, using data collected from local water systems.

e. Analyze how communities deal with water shortages, distribution, and quality in designing a long-term water use plan.

Objective 2

Analyze the physical and biological dynamics of the oceans.

a. Describe the physical dynamics of the oceans (e.g., wave action, ocean currents, El Nino, tides).

b. Determine how physical properties of oceans affect organisms (e.g., salinity, depth, tides, temperature).

c. Model energy flow in ocean ecosystems.

d. Research and report on changing ocean levels over geologic time, and relate changes in ocean level to changes in the water cycle.

e. Describe how changing sea levels could affect life on Earth.

Science language students should use:

groundwater, reservoir, salinity, glacier, biological dynamics, tide, geologic time

STANDARD V: Students will understand that Earth's atmosphere interacts with and is altered by the lithosphere, hydrosphere, and biosphere.

Objective 1

Describe how matter in the atmosphere cycles through other Earth systems.

a. Trace movement of a carbon atom from the atmosphere through a plant, animal, and decomposer, and back into the atmosphere.

b. Diagram the nitrogen cycle and provide examples of human actions that affect this cycle (e.g., fertilizers, crop rotation, fossil fuel combustion).

c. Interpret evidence suggesting that humans are influencing the carbon cycle.

d. Research ways the biosphere, hydrosphere, and lithosphere interact with the atmosphere (e.g., volcanic eruptions putting ash and gases into the atmosphere, hurricanes, changes in vegetation).

Objective 2

Trace ways in which the atmosphere has been altered by living systems and has itself strongly affected living systems over the course of the Earth's history.

a. Define ozone and compare its effects in the lower and upper atmosphere.

b. Describe the role of living organisms in producing the ozone layer and how the ozone layer affected the development of the Earth.

c. Compare the rate at which CO2 is put into the atmosphere to the rate at which it is removed through the carbon cycle.

d. Analyze data relating to the concentration of atmospheric CO2 over the past 100 years.

e. Research, evaluate, and report on international efforts to protect the atmosphere.

Science language students should use:

carbon cycle, climate, decomposer, matter, nitrogen cycle, ozone layer, depletion, fossil fuel, lithosphere

STANDARD VI: Students will understand the source and distribution of energy on Earth and its effects on Earth systems.

Objective 1
Describe the transformation of solar energy into heat and chemical energy on Earth and eventually the radiation of energy to space.

a. Illustrate the distribution of energy coming from the sun that is reflected, changed into heat, or stored by plants.
b. Describe the pathways for converting and storing light energy as chemical energy (e.g., light energy converted to chemical energy stored in plants, plants become fossil fuel).
c. Investigate the conversion of light energy from the sun into heat energy by various Earth materials.
d. Demonstrate how absorbed solar energy eventually leaves the Earth system as heat radiating to space.
e. Construct a model that demonstrates the reduction of heat loss due to a greenhouse effect.
f. Research global changes and relate them to Earth systems (e.g., global warming, solar fluctuations).

Objective 2
Relate energy sources and transformation to the effects on Earth systems.

a. Describe the difference between climate and weather, and how technology is used to monitor changes in each.
b. Describe the effect of solar energy on the determination of climate and weather (e.g., El Nino, solar intensity).
c. Explain how uneven heating at the equator and polar regions creates atmospheric and oceanic convection currents that move heat energy around Earth.
d. Describe the Coriolis effect and its role in global wind and ocean current patterns.
e. Relate how weather patterns are the result of interactions among ocean currents, air currents, and topography.

Science language students should use:
absorbed, Coriolis effect, energy, greenhouse gas, meteorology, radiation, reflected, topography

Appendix D

Sampling Safety

The Stream Side Science Curriculum provides the opportunity for students and teachers to collect data in the field, and work in and around water. To ensure the safety of your students, consider the following guidelines before going out to your sampling site.

How to manage a group in the field

- Have an adult supervisor accompany each group, with six students or less per adult.
- Keep a good line of communication between all groups at all times and have a plan in case students become separated. For example, keep groups within shouting distance and establish a central meeting place.
- Make sure each group has access to a first aid kit and knows how to use it.
- Be aware of medical considerations, such as students with allergies to bee stings.
- Know the causes and early warning signs of hypothermia and heat exhaustion.

How to choose a safe site

- Before the field trip, visit the site to make sure there is easy public access and available parking.
- Avoid areas with steep, slippery banks. Be aware of holes, vertical banks and other hazards that can be especially difficult to see when the banks are very heavily vegetated.
- Scout the area for hazards such as broken glass, rusted wire or poisonous plants.
- Flag these areas to avoid if necessary.

When is it unsafe to enter the stream?

- Moving water is deceptively dangerous. Don't let students enter water over their knees or water that is moving very fast (more than 1 foot per second).
- Cold water can cause hypothermia, even on warm days. Students who intend to enter the water should wear proper clothing (waders or good wading shoes) and should bring a change of clothing.
- Avoid any waters that are obviously polluted or are directly downstream from a pollution discharge pipe.
- Never sample during a lightening storm. Be aware of sudden storms higher in the watershed that could produce flash floods.
- Never let students enter the water if adult supervisors are not present.

Safety guidelines when conducting chemical tests

- Avoid contact between chemicals and eyes, nose, and mouth. NEVER open chemical packets with teeth -- use the scissors provided or tear the packets.
- All the tests are designed to be safe when used correctly, but it is a good idea to avoid touching any chemicals directly.
- After all field activities, wash hands thoroughly. Use lots of water and avoid no-water cleaners.
- The solutions remaining from the tests can be mixed together without any risk. Deposit all liquid waste in a plastic screw-top waste bottle such as a pop bottle. Deposit all solid waste (packets and glass ampoules) in a separate screw top bottle. Liquid waste can be safely flushed down a school drain. Make sure that glass waste is also disposed of safely.

Appendix E

A Note on Units

The Stream Side Science Curriculum uses the metric system throughout the lesson plans and activities. Be sure to stress to your students the importance of using proper units when collecting data. The following conversion chart may be helpful as you work through the activities.

If you know →	Multiply by →	To get
To get ←	Divide by ←	If you know
Length		
inches (in)	2.5	centimeters (cm)
feet (ft)	30.0	centimeters (cm)
yards (yd)	0.9	meters (m)
miles (mi)	1.6	kilometers (km)
Area		
Square inches (in^2)	6.5	square centimeters (cm^2)
square feet (ft^2)	0.093	square meters (m^2)
square yards (yd^2)	0.84	square meters (m^2)
square mile (mi^2)	640.0	acres (acre)
acre (acre)	43,560	square feet (ft^2)
acre (acre)	4,047	square meters (m^2)
acre (acre)	0.405	hectacres (ha)
Mass		
ounces (oz)	28.35	grams (g)
pounds (lb)	0.45	kilograms (kg)
Volume		
teaspoons (tsp)	5.0	milliliters (ml)
tablespoons (tbs)	15.0	milliliters (ml)
fluid ounces (fl oz)	30.0	milliliters (ml)
cups (c)	.24	liters (l)
pints (pt)	.47	liters (l)
quarts (qt)	0.95	liters (l)
gallon (gal)	0.134	cubic feet (ft^3)
gallon (gal)	3.79	liters (l)
cubic feet (ft^3)	0.03	cubic meters (m^3)
cubic feet (ft^3)	28.32	liters (l)
Flow		
cubic feet per second (cfs)	0.03	cubic meters per sec (m^3/s)
cubic feet per second (cfs)	1.98	acre-feet per day (af/day)
cubic feet per second (cfs)	448.8	gallons per minute (gpm)
cubic feet per second (cfs)	646,320	gallons per day (gpd)
Temperature		
degrees Celsius (C°)	(9/5 x °C) + 32	degrees Fahrenheit (°F)
degrees Fahrenheit (°F)	5/9 x (°F – 32)	degrees Celsius (°C)

Other water equivalents

1 cubic foot (ft^3) = 7.48 gallons (gal) = 62.4 pounds of water (lb/ft^3)
1 cubic foot per second (cfs) flowing for one year = 724 acre-feet (af)
1 gallon (gal) = 0.134 cubic feet = 8.34 pounds of water (lb/gal)
1 acre-foot = one and a half football fields 1 foot deep
1 acre-foot = a typical garden hose (5 gpm) flowing continuously for 45 days
1 acre-foot = approximately 3,475,700 12 oz. cans of soda

Appendix F

Glossary

Acid - Any substance that has a pH level below 7, or that has more free hydrogen ions (H+) than hydroxyl (OH-) ions.

Acidity - A measure of the number of free hydrogen ions (H+) in a solution that can chemically react with other substances.

Acre-foot - (AC-FT) is the quantity of water required to cover 1 acre to a depth of 1 foot and is equal to 43,560 cubic feet or about 326,000 gallons or 1,233 cubic meters.

Adaptation - The modification, over time, of the structure, function, or behavior of an organism, which enables it to be better suited to its environment.

Aerobic - Able to live only in the presence of air or free oxygen; conditions that exist only in the presence of air or free oxygen.

Alkalinity - A measure of the negative ions that are available to react and neutralize free hydrogen ions. Some of most common of these include hydroxyl (OH-), sulfate, phosphate, bicarbonate and carbonate.

Ambient - Pertaining to the current environmental condition.

Anaerobic - Able to live and grow only where there is no air or free oxygen; condition that exist only in the absence of free air and free oxygen.

Aquarium - A man-made aquatic environment.

Aquatic zone - The area of the stream channel covered by water.

Aquifer - A geologic formation, or group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.

Assemblage - The set of related organisms that represent a portion of a biological community (e.g., benthic macroinvertebrates).

Atmosphere - The layer of gases surrounding Earth; composed mainly of nitrogen and oxygen.

Backwaters - Areas of water to the side of a main stream channel usually formed by flooding.

Bacteria - Microscopic unicellular organisms, typically spherical, rod-like, or spiral and threadlike in shape, often, clumped into colonies. Some bacteria cause disease, while others perform an essential role in nature in the recycling of materials; for example, by decomposing organic matter into a form available for reuse by plants.

Bar graph - A graph using parallel bars of varying lengths, as to illustrate comparative data.

Base flow - The portion of the stream flow that is relatively consistent throughout the year.

Basic - Alkaline. Basic water contains high concentrations of hydroxyl ions (OH-).

Beneficial use - The legal, designated uses for a waterbody including, drinking, recreation, fish and wildlife, etc. Water quality standards are designed to support a waterbody's beneficial use(s).

Benthic - Pertaining to the bottom (bed) of a waterbody.

Biochemical oxygen demand (BOD) - A measure of the quantity of dissolved oxygen, in milligrams per liter, necessary for the decomposition of organic matter by micro-organisms, such as bacteria.

Biodiversity - A measure of the distinct characteristics, qualities, or elements of plant and animal life in a defined area; a measure of biological differences.

Biological integrity - The condition of the aquatic community inhabiting unimpaired water bodies as measured by community structure and function.

Biomass - the amount of living matter (as in a unit area or volume of habitat).

Buffer - To maintain high pH levels. Alkaline soils keep the pH of water from getting too low.

Capillary action - Forces of adhesion and cohesion help water to move through the soil from areas of greater concentration to areas of lesser concentration.

Cause - The producer of an effect.

Channel - The section of the stream that contains the main flow.

Channelization - The straightening of a stream; this often is a result of human activity.

Collectors - Macroinvertebrates that collect bits of food from the water column.

Community - The whole of the plant and animal population inhabiting a given area.

Culvert - Man-made construction that diverts the natural flow of water.

Comparability - The degree to which we can compare data between dates and locations.

Concentration - The amount of a specific substance dissolved in a given amount (volume) of another substance.

Condensation - The process by which a vapor becomes a liquid; the opposite of evaporation.

Contaminant - Any substance that when added to water (or another substance) makes it impure and unfit for consumption or use.

Control - A standard for comparing, checking, or verifying the results of an experiment or activity.

Correlation - The mutual relation of two or more things.

Cubic foot per second (ft^3/s) - Units typically used in measuring streamflow that express rate of discharge. The measurement is equal to the discharge in a stream cross section one foot wide and one foot deep, flowing with an average velocity of one foot (or meter) per second; 1 cfs = 44.8 gallons per minute (gpm); 1 cms = 1,000 liters per second.

Decomposition - The breakdown or decay of organic matter through the digestive processes of microorganisms, macroinvertebrates, and scavengers.

Density - The compactness or crowdedness of matter (ex. water molecules) in a given area.

Deposition - The process of laying down sediment or accumulating layers of material carried in suspension.

Designated beneficial uses - State-established desirable uses that waters should support, such as fishing, swimming, and aquatic life. Listed in state water quality standards.

Detection limit – The lowest point at which a particular piece of sampling equipment can accurately assess chemical concentrations.

D-frame net - A fine mesh net that is attached to a pole and used for sampling. It resembles a butterfly net.

Dichotomous key - A tool for identifying objects, such as macroinvertebrates. The key presents a series of "yes or no" questions to the observer; each question brings the observer closer to the identification.

Discharge - The volume of water (or more broadly, volume of fluid plus suspended sediment) that passes through a cross-section of the channel within a given period of time.

Discharge limits - Any restriction on quantities, rates, and concentrations of chemical, physical, biological or other constituents which are discharged from point sources.

Dissolved Solids - These are dissolved materials that can pass through a standard glass-fiber filter with about one micrometer pore size.

Dissolved oxygen (DO) - Oxygen dissolved in water and available for living organisms to use for respiration.

Distillation - The purification of water. When water evaporates the vapor separates from impurities.

Distilled water - Water that has had most of its impurities removed.

Downstream - In the direction of a stream's current; in relation to water rights, refers to water uses or locations that are affected by upstream uses or locations.

Drainage basin - Part of the surface of the earth that is occupied by a drainage system, which consists of a surface stream or a body of impounded surface water together with all tributary surface streams and bodies of impounded surface water. See watershed.

Ecosystem - A community of living organisms and their interrelated physical and chemical environment; also, a land area within a climate.

Effluent - Waste material discharged into the environment, including waters of the United States.

Emergent plants - Plants rooted underwater, but with their tops extending above the water.

Engulfers - Macroinvertebrate predators that feed by swallowing their prey whole.

Environment - All of the external factors, conditions, and influences that affect an organism or a biological community.

Ephemeral - Occurs intermittently. Ephemeral streams flow only during and shortly after extreme precipitation or snowmelt events.

EPT Value - A index of water quality derived from the percent of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Tricoptera (caddisflies) in a 100-individual sample of macroinvertebrates..

Erosion - The wearing down or washing away of the soil and land surface by the action of water, wind or ice.

Erosive - The power of wind or water to wear away sediment. Highly erosive water can wear away more sediment.

Eutrophic - A condition in which the water in a lake, pond, or reservoir is enriched with plant nutrients such as nitrogen and phosphorous which results in large amounts of plant and algal production. As the plants and algae die and sink to the bottom, an organic sediment is created which removes oxygen from the water as it decays.

Evaporation - The conversion of a liquid (ex. water) into a vapor (a gaseous state) usually through the application of heat energy; the opposite of condensation.

Evapotranspiration - The loss of water from the soil through both evaporation and transpiration from plants.

Floating plants - Plants that grow free floating, rather that being attached to the streambed.

Flood - Any relatively high streamflow overtopping the natural or artificial banks of a stream.

Floodplain - Any normally dry land area that is susceptible to being inundated by water from any natural source; usually lowland adjacent to a stream or lake.

Forbs - Plants with broad leaves and net-like veins; stems are solid and spongy and die back to the ground every year.

Functional feeding groups - Classification of macroinvertebrate groups according to their mode of feeding.

Gas (gaseous) - The state of water in which individual molecules are highly energized and move about freely; also known as vapor.

Glide/run - A section of a stream with a relatively high velocity and with little or no turbulence on the surface of the water.

Gradient - A measure of degree of incline; the steepness of slope.

Grass - Plants with hollow stems that are jointed and leaves with parallel veins. The leaves come off the stem opposite to each other.

Gravity - The natural force of attraction exerted by Earth on objects or materials on its surface that tends to draw them down toward its center.

Greenline - A line of vegetation that runs alongside the stream. It is the first line of vegetation you encounter as you move away from the water.

Groundwater - Water found in spaces between soil particles underground (located in the zone of saturation).

Habitat - The environment occupied by individuals of a particular species, population, or community.

Headwaters - The source of a stream.

Hydrograph - A representation of water discharge over time.

Hydrology - The study of Earth's waters, including water's properties, circulation, principles and distribution.

Hydrophilic - Water-loving.

Impaired waters - Waters that fail to meet applicable water quality standards or to protect designated uses (such as fishing or swimming).

Independent variable - A factor in a relationship that is not affected by the relationship. Time is a common independent variable.

Indicator - A gauge of water pollution: not legal criteria but, rather a sign that there may be a problem. When an indicator level is exceeded, further studies are done.

Instream flow - The minimum amount of water required in a stream to maintain the existing aquatic resources and associated wildlife and riparian habitat.

Instream use - Uses of water within a stream's channel (ex. by fish and other aquatic life, or for recreation, navigation and hydroelectric power production).

Intermittent - A stream that does not flow year round.

Irrigation - The controlled application of water to cropland, hay fields, and/or pasture to supplement that supplied by nature.

Kick-net - A fine mesh net used to collect organisms. Kick-nets vary in size, but generally are about three feet long and are attached to two wooden poles at each end.

Land uses - activities that take place on the land, such as construction, farming, or tree clearing.

Large woody material - Fallen trees and limbs in a stream.

Larva - The immature, wingless, feeding stage of an insect that undergoes complete metamorphosis.

Line graph - An illustration of data points where individual points are connected by a line. Line graphs show a continuous trend.

Litter - Dead plant material on the ground.

Macroinvertebrate - Organisms that lack a backbone and can be seen with the naked eye.

Mainstem - The primary path for waterflow in a watershed.

Mean - Average. The sum of all the measurement values divided by the number of measurements.

Meandering - The curving pattern of a stream channel.

Metabolism - The physical and chemical processes in an organism that produce energy and result in the production, maintenance, or destruction of materials in the body. Many metabolic processes involve water.

Metal - An elementary substance, such as gold or silver, which is crystalline when solid and yields positively charged ions in aqueous solutions of its salts. Metals can be very toxic in streams at low concentrations.

Metamorphosis - A change in form from one stage to the next in the life history of an organism, as from the caterpillar to the pupa and from the pupa to the adult butterfly.

Miilligrams per liter (mg/1) - Used to refer to the concentration of a substance in the water; milligram of a substance dissolved in one liter of water.

Minimum instream flow requirements - Regulations set by management agencies that determine the least amount of water a stream can hold. Requirements protect the aquatic ecosystem and balance competing out-of-stream uses.

Municipal water system - A network of pipes, pumps, and storage and treatment facilities designed to deliver potable water to homes, schools, businesses and other users in the city or town and to remove and treat waste materials.

Narrative criteria - Chemical, physical or biological concentrations in water that are expressed in words.

National Pollutant Discharge Elimination System (NPDES) - A national program in which pollution dischargers such as factories and sewage treatment plants are given permits to discharge. These permits contain limits on the pollutants they are allowed to discharge.

Nephelometer (turbidity tube) – A clear tube used to measure the turbidity of a stream or waterbody.

Nephelometric turbidity unit (NTU) – A unit used to describe turbidity measurements.

Neutral – A substance, such as distilled water, with a pH of 7.

Nitrate – A nitrogen compound (NO3) that functions as a plant nutrient. An overabundance of nitrate is considered a water pollutant.

Nitrite – A combination of nitrogen, ammonia and oxygen (NO2) that functions as a plant nutrient. An overabundance of nitrite is considered a water pollutant.

Nitrogen fixation – Changing nitrogen gas into ammonia. Some plants and algae fix nitrogen.

Nonconsumptive uses – Instream use of water that does not reduce the supply; or, removing water and returning it to the source without reducing the supply.

Nonpoint source pollution – Refers to pollution sources that are diffuse and do not have a single point of origin. Run-off from agriculture, forestry and construction sites are examples.

Numeric criteria – Chemical, physical or biological concentrations in water that are typically expressed as concentrations, such as milligrams per liter.

Nutrient – An element, such as nitrogen or phosphorus, or compound needed for the reproduction, survival or growth of plants and animals.

Nymph – The young of an insect that undergoes incomplete metamorphosis

Occular tube – A device used to measure canopy cover.

Organic - Of, related to, or derived from living organisms. Organic substances contain carbon.

Parameter – A distinguishing characteristic or feature. For example, nitrate is a water quality parameter.

Parts per million (ppm)/parts per billion (ppb) - Units typically used in measuring the number of “parts” by weight of a substance in water; commonly used in representing pollutant concentrations.

Pathogen - A disease-producing agent, especially a microorganism.

Peak flow – The largest rate of flow during a certain time period.

Piercers – Macroinvertebrate predators that feed by injecting a sharp mouth part into their prey and sucking out body fluids.

Percent saturation – The amount of dissolved oxygen in water compared to the amount of dissolved oxygen the water can hold.

Percolation – Describes the action of water as it moves through spaces in the soil and rock.

Perennial – Occurs year-round. Perennial streams hold water throughout the year.

Permit – Legal authority to carry out a regulated activity.

pH - A numerical measure of the hydrogen ion concentration used to indicate the alkalinity or acidity of a substance. Measured on a scale of 1.0 (acidic) to 14.0 (basic); 7.0 is neutral.

Photosynthesis - The chemical reaction in plants that utilizes light energy from the sun to convert water and carbon dioxide into simple sugars. This reaction is facilitated by chlorophyll.

Pipette - An eye dropper-like instrument that can measure very small amounts of a liquid.

Point source pollution - Refers to pollution resulting from discharges into receiving waters from any discernible, confined and discrete conveyance such as a pipe, ditch, or sewer.

Pool - A deeper portion of a stream where water flows slower than in neighboring, shallower portions.

Precipitation - Water falling, in a liquid or solid state, from the atmosphere to Earth (e.g., rain, snow).

Predator - An animal, such as a macroinvertebrate, that feeds on other animals.

Protocol - A defined procedure.

Reagent - A substance or chemical used to indicate the presence of a chemical or to induce a chemical reaction to determine the chemical characteristics of a solution.

Representative - Accurately depicting the true characteristics of the stream.

Reservoir - A still, lake-like waterbody that forms upstream from a dam. Reservoirs store water and often provide for recreation.

Riffle - A shallow area in a stream where water flows swiftly over gravel and rock.

Riparian zone - The vegetative area on each bank of a body of water that receives flood waters.

Run/glide - See glide/run.

Runoff - Precipitation that flows overland to surface streams, rivers, and lakes.

Rushes - Similar to sedges but have round (verses triangular) stems and very small or no leaves. Rushes stabilize stream banks and prevent erosion.

Saturated - Inundated; filled to the point of capacity or beyond.

Saturation concentration – The amount of dissolved oxygen a body of water can hold.

Scrapers - Macroinvertebrates that feed by scraping algae and other material from the surface of plants, wood and rock. Also known as grazers.

Season - A period of time during the year classified by length of day and weather conditions.

Sedges - Sedges resemble grasses but have solid, triangular stems with no joints. The leaves have parallel veins and come off the stem in three directions. Sedges are effective at stabilizing stream banks and preventing erosion.

Sediment - Solid material that originates mostly from disintegrated rocks and is transported by, suspended in, or deposited from water; it includes chemical and biochemical precipitates and decomposed organic material such as humus. The quantity, characteristics, and cause of the occurrence of sediment in streams are influenced by the quantity and intensity of precipitation.

Shredder - A macroinvertebrate that feeds by cutting or tearing on leaves and woody material that falls into the stream.

Shrubs - Plants with woody stems that remain alive all year. The leaves tend to have net-like veins. Shrubs rarely grow larger than 13 ft tall; if they do they may be considered "trees."

Siltation - An increased supply of fine sediments to a stream bottom or channel. Siltation can cover up and harm fish spawning areas and macroinvertebrate habitat.

Sinuosity - The degree to which a stream meanders, or curves.

Soil - The top layer of Earth's surface, containing unconsolidated rock and mineral particles mixed with organic material.

Solids - Water, a liquid, can contain quite a bit of solid material, both in dissolved and suspended forms. Solids captured on the filter are, by definition, "suspended" solids. Solids which settle out of a water sample on standing for a period of an hour are defined as "settlable."

Soluble - Able to be dissolved in water.

Solute - A substance dissolved in another substance (the solvent) create a solution.

Solvent - A material such as water that dissolves another substance (the solute) to form a solution.

Spreadsheet - A work sheet that is arranged in the manner of a mathematical matrix and contains a multicolumn analysis of related entries for easy reference on a single sheet.

Stream - A channel of water that flows as a function of gravity and elevation across the Earth's surface.

Streamflow - The discharge that occurs in a natural channel. Although the term "discharge" can be applied to the flow of a canal, the word "streamflow" uniquely describes the discharge in surface stream course. The term "streamflow" is more general than "runoff" as streamflow may be applied to discharge whether or not it is affected by diversion or regulation.

Submergent plants - Plants that live and grow fully submerged under the water.

Substrate - Refers to a surface. This includes the material comprising the zstreambed or the surfaces which plants or animals may attach or live upon.

Surface runoff - Water that flows over the surface of the land or through the upper layer of soil.

Surface water - Water above the surface of the land, including lakes, rivers, streams, ponds, floodwater, and runoff.

Suspended solids - Particles carried in water without being dissolved.

Taxon (plural taxa) - A level of classification within a scientific system that categorizes living organisms based on their physical characteristics.

Taxonomic key - A quick reference guide used to identify organisms. They are available in varying degrees of complexity and detail.

Temperature - The measurement of the average kinetic energy of moving molecules within a substance.

Tolerance - The ability to withstand a particular condition - (e.g., pollution tolerant indicates that ability to live in polluted waters).

Topography - The shape of the land's surface.

Toxic - Poisonous or damaging.

Turbidity - Murkiness or cloudiness of water, indicating the presence of some suspended sediments, dissolved solids, natural or man-made chemicals, algae, etc.

Turbidity tube (nephelometer) - A clear tube for measuring the turbidity of a stream or waterbody.

Uplands zone - The area of the watershed that does not receive regular flooding by a stream. The uplands zone borders the riparian zone.

Upstream - Toward the source or upper part of a stream; against the current. In relation to water rights, refers to water uses or locations that affect water quality or quantity of downstream water uses or locations.

Utah State Standard - The legally designated allowable concentration of an impurity in a water body. Concentrations over this state standard are considered as pollution.

Velocity - The speed of water flow.

Volume - The amount of water in a stream.

Wastewater - Water that contains unwanted materials from homes, businesses, and industries; a mixture of water and dissolved or suspended substances

Wastewater treatment - Any of the mechanical or chemical processes used to modify the quality of wastewater in order to make it more compatible or acceptable to humans and the environment.

Water (H_2O) - An odorless, tasteless, colorless liquid made up of a combination of hydrogen and oxygen. Water forms streams, lakes, and seas, and is a major constituent of all living matter. The word water and important concepts related to water appear on almost every page of this text.

Water allocation - In a hydrologic system in which there are multiple uses or demands for water, the process of measuring a specific amount of water devoted to a given purpose.

Water cycle - The paths water takes through its various states-vapor, liquid, and solid-as it moves throughout Earth's systems (oceans, atmosphere, ground water, streams, etc.). Also known as the hydrologic cycle.

Water quality - The chemical, physical, and biological characteristics of water with respect to its suitability for a particular use.

Water quality criteria - Maximum concentrations of pollutants that are acceptable, if those waters are to meet water quality standards. Listed in state water quality standards.

Water quality rating index - An index of water quality derived from a 100-individual sample of macroinvertebrates. The more pollution-intolerant individuals found in the sample the better the water quality.

Water quality standard - Recommended or enforceable maximum contaminant levels of chemicals or materials (e.g. nutrients). In relation to water rights, refers to water uses or locations that affect water quality or quantity of downstream water uses or locations.

Water right - A legal right to use a specified amount of water for beneficial purposes.

Watershed - The land area from which surface runoff drains into a stream channel, lake, reservoir or other body of water; also called a drainage basin.

Water table - The top of an unconfined aquifer; indicates the level below which soil and rock are saturated with water.

Wetlands - Lands where water saturation is the dominant factor determining the nature of soil development and the types of plant and animal communities. Other common names for wetlands are sloughs, ponds and marshes.