Introduction to Water Quality Monitoring
Life Science: Grades 4-8

Enduring Understandings

1. Understand and be able to list and describe important water quality factors (temperature, transparency, pH, electrical conductivity, alkalinity) and describe natural conditions and human activities that affect each factor.
2. Understand that water quality factors are interrelated and change over time as a result of both natural and anthropogenic conditions.
3. Understand that water quality affects aquatic life and human uses of water.
4. Accurately implement scientific protocols and use scientific equipment and technology to accurately collect data and communicate results to appropriate audiences.
5. When appropriate, use protocols learned in the laboratory to conduct water quality field work at a nearby riparian area and analyze and interpret data and communicate results to appropriate audiences.

Enduring Understanding(s)	**Activity**	**Concept(s)**	**Arizona Education Standards**	**Materials Needed**
1, 2, 3	The GLOBE Program, the Hydrologic Cycle and Riparian Areas	Hydrologic cycle Riparian areas Watersheds Ecosystems Surface Water – Temporary or Permanent Aquatic Life Impacts on riparian areas Factors affecting riparian areas	**Language Arts** Reading: Strand 1: Concept 4-6 Strand 3: Concept 2 W-E1 **Science** Strand 1: Concept 1 Strand 3: Concept 1 Strand 4: Concept 3 Strand 6: Concept 2, 3 **Social Studies** 3SS-E2 3SS-E7 3SS-E8	Student Manual Transparency of the hydrologic cycle GLOBE Special Topics video (GLOBE Program Overview) Any visual material about your study site
2, 3	The Blue Traveler (Discover a Watershed, p. 15)	A simulation of the movement of water within and between natural and constructed systems. Understanding	**Language Arts** Reading: Strand 1: Concept 4 **Science** Strand 2: Concept 1, 2	9 Natural system game boards and explanation cards 9 Natural system station cards 19 natural/constructed system game boards and explanation cards 19 natural/constructed system

		water's movement on the planet supports water conservation measures.	Strand 3: Concept 1, 2 Strand 4: Concept 1 Strand 5: Concept 1 Strand 6: Concept 1-3 **Social Studies** 3SS-E2 3SS-E7	station cards 19 dice *Water Journey Map, Part I* (one per student) *Water Journey Map, Part II* (one per student) *Water Molecule Movement* (one per student)
1, 2, 3, 4, 5 – if use field site	Water Temperature	Temperature allows us to better understand other hydrology measurements such as pH, dissolved oxygen, and conductivity. Temperature influences the amount and diversity of aquatic life. Water temperature is important for understanding local and global weather patterns.	**Language Arts** Reading: Strand 1: Concept 4-6 Strand 3: Concept 2 W-E1 **Science** Strand 1: Concept 1, 2, 3, 4 Strand 2: Concept 2 Strand 3: Concept 1 Strand 4: Concept 3 **Mathematics** 1M-E3 1M-E5 1M-E6	Student Manual Transparencies: Optimal Temperature Ranges for Aquatic Life, Hot Discussion Topic – Thermometers GLOBE Water Temperature Protocol Field Guide – 2 for each group 7 Thermometers 7 Beakers of water at room temperature labeled 1-7 Clock or watch
1, 2, 3, 4 5 – if use field site	Electrical Conductivity and pH	Fresh water has many natural impurities. These impurities include salts or minerals we cannot always see or smell. We call the amount of mineral and salt impurities in the water the total dissolved solids (TDS). One way to measure impurities in water is to find out if it conducts electricity. pH measures the acid content of water. Solutions with a pH	**Language Arts** Reading: Strand 1: Concept 4-6 Strand 3: Concept 2 W-E1 **Science** Strand 1: Concept 1, 2, 3, 4 Strand 2: Concept 2 Strand 3: Concept 1 Strand 4: Concept 3 **Mathematics** 1M-E3 1M-E5 1M-E6	Student Manual GLOBE Electrical Conductivity Protocol Field Guide – 2 for each group GLOBE Using a pH Protocol Field Guide (both EC greater than 200 µS/cm and the EC less than 200 µS/cm) – 2 for each group 4 pH meters 4 EC meters 7 Thermometers 14 labeled cups 7 wash bottles with distilled water 7 tweezers 2 liters distilled water (be sure pH is close to 7)

		greater than 7.0 are classified as basic and ones with a pH less than 7.0 as acidic. pH affects most chemical and biological processes in water. pH has a strong influence on what can live in the water.		Salt, baking soda, vinegar, sugar, seltzer water Clock or watch
1, 2, 3, 4 5 – if use field site	Alkalinity	Alkalinity is the measure of the pH buffering capacity of the water. Alkalinity comes from dissolved rocks, especially limestone and soils. When water has high alkalinity, it resists a decrease in pH when acidic water enters it. When water has low alkalinity, it cannot resist a decrease in pH when acidic water enters it.	**Language Arts** Reading: Strand 1: Concept 4-6 Strand 3: Concept 2 W-E1 **Science** Strand 1: Concept 1, 2, 3, 4 Strand 2: Concept 2 Strand 3: Concept 1 Strand 4: Concept 3 **Mathematics** 1M-E3 1M-E5 1M-E6	Student Manual GLOBE Alkalinity Protocol Field Guide – 2 for each group Instructions for using alkalinity kit (from the kit) GLOBE Using a pH Meter Protocol Field Guide(EC greater than 200 µS/cm) – 2 for each group 8 alkalinity kits 4 pH meters 1 EC meter 8 labeled cups filled with different water samples (see teacher manual) 8 wash bottles with distilled water 8 waste water containers 2 liters distilled water (be sure pH is close to 7) Gloves and goggles Salt, baking soda, vinegar Eye dropper Clock or watch
1, 2, 3, 4 5 – if use field site	Transparency	Suspended particles in our water behave similarly to dust in the atmosphere. They reduce the depth to which light can penetrate. How deeply light penetrates into a water body determines the depth to which aquatic plants can grow.	**Language Arts** Reading: Strand 1: Concept 4-6 Strand 3: Concept 2 W-E1 **Science** Strand 1: Concept 1, 2, 3, 4 Strand 2: Concept 2 Strand 3: Concept 1 Strand 4: Concept 3	Student Manual 1 Transparency tube (or more if students are conducting activity)

			Mathematics 1M-E3 1M-E5 1M-E6	
1, 2, 3, 4 5 – if use field site	Mapping It Out (Healthy Water Healthy People, p.6)	Use KWL and Concept Mapping to discover what students know, what they want to know, and what they learned about water quality.	**Science** Strand 1: Concept 1, 2, 3, 4 Strand 2: Concept 2 Strand 3: Concept 1 Strand 4: Concept 3	3 Large sheets of poster paper Black marking pen Red marking pen
1, 2, 3, 4	Grab a Gram (Healthy Water Healthy People, p.29)	Use familiar objects to gain an introduction to basic water quality measurements like parts per million (ppm) and milligrams per liter (mg/L). Compare measurements to national drinking water standards to determine toxicity levels of a contaminant.	**Language Arts** Reading: Strand 1: Concept 4-6 Strand 3: Concept 2 W-E1 **Science** Strand 1: Concept 1, 2, 3, 4 Strand 2: Concept 2 Strand 3: Concept 1 Strand 4: Concept 3 **Mathematics** 1M-E1 1M-E3 1M-E5 1M-E6 3M-E8 5M-E1 5M-E3 6M-E1	Items that weigh about one gram (sugar packet, raisin, paper clip, etc.) Items that weigh more and less than one gram (staple, clothespin, pen, etc.) 1 liter bottle filled with water (1 per group, or can use one to demonstrate to whole class) Approximately 1 kg (2.2 pounds) of sand, sugar, or salt (1 kg per group, or 1 kg to demonstrate to whole class). Business card with at least 25 tiny pieces cut out of it. *Water Quality Measurement Student Copy Page* – one for each student. *Comparison of International Drinking Water Guidelines Student Copy Page* –one for each student.
4	Hitting the Mark (Healthy Water Healthy People, p.49)	Investigate the concepts of accuracy and precision in data collection, and learn the importance of writing detailed procedures.	**Language Arts** Reading: Strand 1: Concept 4-6 Strand 3: Concept 2 W-E1 **Science** Strand 1: Concept 1, 2, 3, 4 Strand 2: Concept 2 Strand 3: Concept 1 Strand 4: Concept 3 **Mathematics**	*Accuracy and Precision Illustrations Teacher Copy Page* – one copy for each group or made into overhead for class to see. Clay – enough for each groups to have at least a 3”x1”x1” piece). *Target Student Copy Page* - one for each group. Meter stick or tape measure Pencils and paper Colored pencils, markers, or crayons (at least 3 different colors for each group.

			2M-E1	
1, 2, 3, 4	A Snapshot in Time (Healthy Water Healthy People, p.61)	Explore the concept of watershed and apply to watershed monitoring. Discern the differences in value between an individual data set collected at one place and time on a watershed versus a series of water quality data sets collected at various points along a watershed over time. Graph watershed data then analyze, compare, and summarize trends in water quality.	**Language Arts** Reading: Strand 1: Concept 4-6 Strand 3: Concept 2 W-E1 **Science** Strand 1: Concept 1, 2, 3, 4 Strand 2: Concept 2 Strand 3: Concept 1 Strand 4: Concept 3 **Mathematics** 2M-E2 3M-E4 3M-E7	Pencils Graphing paper *Cooper River Watershed Map* – one for each student *Watershed Data Summaries Worksheet* – one for each student *Cooper River Water Data Cards* – laminated
1, 2, 3, 4	Turbidity or Not Turbidity (Healthy Water Healthy People, p.83)	Explore the effects of sediment on turbidity, compare turbidity of muddy and clear water, simulate environmental conditions that cause erosion, and investigate ways to reduce erosion that leads to turbidity in adjacent waterways.	**Language Arts** Reading: Strand 1: Concept 4-6 Strand 3: Concept 2 W-E1 **Science** Strand 1: Concept 1, 2, 3, 4 Strand 2: Concept 2 Strand 3: Concept 1 Strand 4: Concept 3 **Mathematics** 2M-E2 3M-E4 3M-E7	Clear plastic (or glass) quart jar filled with assorted rocks, gravel, soil, sand, and water Copies of *Turbidity Test Student Copy Page* – one for each group Turbidity test materials Flat-bottomed test tubes (preferred) or clear juice glasses (one per group) Fine-grained soil (e.g., silt) or milk Sample of clear water Sample of local surface water for comparison Optional: eyedropper, coffee filter Rope or string (about 15 meters) 200 tokens (acorns, leaves, twigs, packaging peanuts, balls, other) Pencils Paper
2, 3	There Is No Point To This Pollution	The leading source of water quality degradation is	**Language Arts** Reading:	Large clear bowl, 2-liter bottle with top cut off, jar, or baking dish

	(Healthy Water Healthy People, p.136)	nonpoint source (NPS) pollution, which occurs when runoff carries pollutants to surface water bodies. Common NPS pollutants include sediments, nutrients, pesticides, and petroleum products. Steps can be taken to reduce the amounts of NPS pollutants that reach surface water bodies.	Strand 1: Concept 4-6 Strand 3: Concept 2 W-E1 W-P1 **Science** Strand 1: Concept 1, 2, 3, 4 Strand 2: Concept 2 Strand 3: Concept 1 Strand 4: Concept 3 **Math** 2M-P1 2M-P2 3M-P2 **Social Studies** 3SS-E4 3SS-E7 3SS-E8 3SS-P1 3SS-P2 3SS-P4	Water Clear plastic cups Assorted food coloring Powdered cocoa or hot chocolate mix Cooking oil Eyedropper Copies of *Loop Lake Worksheet*, *Loop Lake Map*, *Water Quality Data*, and *Water Quality Graphs* (1 of each per group)
1, 2, 3	Water Quality Windows (Healthy Water Healthy People, p.164)	Every species has a habitat that is most favorable to its survival. Aquatic organisms vary in their tolerance of different ranges in temperature, dissolved oxygen, salinity, and pH.	**Language Arts** Reading: Strand 1: Concept 4-6 Strand 3: Concept 2 W-E1 **Science** Strand 1: Concept 1, 2, 3, 4 Strand 2: Concept 2 Strand 3: Concept 1 Strand 4: Concept 3 **Social Studies** 3SS-E2 3SS-E7	One copy of *Organism Cards Teacher Copy Pages* One copy of *Water Quality Windows Teacher Copy Page* One copy of *Answer Key Teacher Copy Page* Pencils and paper