Stream Side Science SEEd modification of What's in the Water? Combined with Who's in the Water?

Standard 6.4.1 Learning Episode 1	
Title: Water Tests	**Overview:** Students will explain how to measure water quality parameters and research why they are important.
Overarching Performance Expectations (Standard): 6.4.1 Analyze data to provide evidence for the effects of resource availability on organisms and populations in an ecosystem. Ask questions to predict how change in resource availability affects organisms in those ecosystems. Examples could include water, food, and living space in Utah environments.	
Lesson Performance Expectations: Plan and explain an investigation to test water quality parameters that affect life on a nearby water ecosystem. **CCC:** Cause and Effect **SEP:** Planning and Carrying out investigations	

GATHER	
Student Purpose	**Teacher Guidance**
1. Review list of nonliving and living components within the water system. Look at the ones that were circled as possible factors to determine water quality. Students are asked the question; How could these factors be measured? 2. Students will record their ideas on the group paper labeled measurements. Before students turn in this paper, have them write their names on the paper, this will help the teacher organize testing groups.	1. Teacher hands out paper titled, "Measurement Ideas" Measurement Ideas.docx. Ask students how they think some of the nonliving/living things in the water can be measured. Have students list their names and ideas on group measurement paper. This paper will be used to organize groups for field testing. 2. Teacher collects measurement paper from each group. The teacher can then connect the student ideas for measurement with a specific water test. An example assignment list; Group 1: Ruler length = turbidity tube Group 2: color matches, acidity= pH Group 3: color matches, mass (mg/L)= Oxygen Group 4: color matches, mass (mg/L) =Nitrogen Group 5: digital readings, heat, shade, sun= temperature Group 6: Classification, Identification= algae Group 7: Tallies, %, classification, counting=Macroinvertebrates *group assignments will depend on supplies available and number of students in class.
Teacher Preparation: Make copies of Measurement student sheets to give to each group. See student sheets at end of section for copy if word document link is not working.	

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REASON	
Student Purpose	**Teacher Guidance**
1. Students choose roles; leader, manager, instructor, recorder, and expert (if 5 in a group). 2. Write a chart in their journals. The 3 column headings will be; What is being Measured? Procedure, Why is this Important? **3.** Students within their groups will work together to fill out the chart. The leader will have to guide the group. Leaders will direct the managers to explain what the test is. The managers will find this information on the resource page. The leaders will have to make sure the recorders write information down as each person shares the information they are responsible for. The leaders will have to direct the instructors to model and explain the procedure for doing the test measurements. The leaders will prompt the experts/managers to explain why this test is important. 4. At this point all students in the group should fill in their own charts and help the presenter refine the chart he/she will reference during his/her presentation to the class.	1. Showcase and then pass out testing materials, resource pages, and instruction sheets according to matches made using measurement student sheets in the gather section. 2. Direct attention to the 4-5 student roles written on the board; (manager and expert can be the same role if only 4 students in a group) • Leader (directs group research, presents water test background to class, will be wearing waders for field day). • Manager (uses resource pages to learn about the water factor, in charge of testing materials) • Instructor (reads instruction sheet to group, works with manager to get familiar with test materials) • Expert (uses the resource page to explain to their group why this factor is important) • Recorder (fills in chart for leader to reference during presentation) 3. Assign students to choose their role. (see management strategies) 4. Put up a 3-column chart for students to copy into their journals. The chart should be labeled; What is measured? Procedure, and Why is this important? 5. Teacher can have one group play act the roles of each person. Model the leader directing the discussion. Match the managers/experts to materials and resource sheets. Make sure instructors have instruction sheets. Verify that recorders know what to record. 6. Remind students that the leader of the group will present to the class what the group learned. Through this

	process each group becomes an expert at their assigned water test.

Teacher Preparation: Before the lesson, teachers will need to laminate or sheet protect instruction and resource sheets for each factor being measured. Testing materials should be matched to instruction and resource sheets. For example, thermometers will be paired with temperature resource and instruction sheets, turbidity tubes with turbidity instruction and resource sheets, etc... Materials will then be ready to match to the student expert groups. See links to streamside science for copies of instruction and resource sheets and for a material list that references where to buy supplies.
Water Chemistry-
http://streamsidescience.usu.edu/ou-files/ezplug/uploads/Whats_in_the_Water/SSS-_Whats_in_the_Water.pdf
Macroinvertebrates-
http://streamsidescience.usu.edu/ou-files/ezplug/uploads/Who_lives_in_the_water/-SSS_Who_Lives_in_the_Water.pdf

Management Strategies
Write group roles on the board so students can choose their role and know the expectation of that role. Emphasize to the class that all roles are equally important. Remind students that if they do their best to help the group learn the material, their leader can teach the rest of the class about the water test so the whole class can have background on why and how each of the tests are being measured.

Role Assignment:
1. Roles can be written on the board with descriptions and students can self-select, add in rock, paper, scissors if a group is having difficulty deciding.
2. Objects in the room can be used to assign roles, i.e., all students sitting on the window side will be leaders, those facing the clock will be instructors, those nearest the door are the managers, etc.
3. Role cards with descriptions can be randomly passed out to members of a group.

COMMUNICATE

Student Purpose	**Teacher Guidance**
The leader of each group will present to the class what the parameter is, how it will be measured, and why it is important to measure. During presentations students will be locating where these measurements will be recorded on student field data sheets. This will help prepare students for field data collection. Students will fill in data sheets after field	Leaders should be prepared to present to the class • The name of the test • explanation of what it is • how it will be measured • why it is important. Direct student presenters to stand in front of the class and reference notes to make sure

testing is completed.	they give the class a complete description of the variable being tested. Prior to presentations pass out student field data sheets for reference. Inform students that after field testing they will share information with one another to complete the water data table.

Teacher Preparation
Copy class set of student field data sheets for students to reference during presentations.
Field Data Student Worksheet.docx

Management Strategies
Forming Test Groups for Field Data Day

Presentations are to familiarize students with all the test measurements they will make while in the field. Groups can be set up in one of two ways for field testing. If time and equipment is limited, have students remain in expert groups, have them test and record the one parameter they have researched and bring information back to class to share.

If more time is available and there are enough supplies, such that each group can have a test kit complete with all tests, have the students jigsaw into new groups where each group has an expert. To jigsaw groups assign a number 1-7 (dependent on number of groups) to each person in the expert groups. Then have all the ones sit together, all the twos sit together, ect. Each new group should have a representative that knows about each test. These new groups will have a kit complete with all water test materials so they can collect data for each test while in the field.

Notes for setting up this unit
Instruction sheets can be found on these links. Print and laminate these so students can use this to get acquainted with the water tests and so that they will have them when they are in the field collecting samples.
Water Chemistry Instruction sheets- http://streamsidescience.usu.edu/ou-files/ezplug/uploads/Whats_in_the_Water/SSS_Whats_in_the_Water.pdf
Macroinvertebrate instruction sheets- http://streamsidescience.usu.edu/ou-files/pdfs/macroinvertbrae-investigation.pdf
Field Algae ID: http://extension.usu.edu/utahwaterwatch/ou-files/Instructions/HABFieldID.pdf
Lab cyanobacteria ID: http://extension.usu.edu/utahwaterwatch/ou-files/Instructions/ID_Sheet.pdf
The Utah link to report cyanobacteria (harmful algae) findings can be found at: https://goo.gl/forms/EIcXydLsPHJ5hdv82

When organizing groups for the field trip the students can remain in their one test expert

groups and share information later in class. The other way to set this up is have a kit for each group with all materials in it (as explained in the Streamside Science) then each group will do all tests. This will depend on how much time the field data collection has. If it is more than a half day and students are visiting multiple sites then each should have a full kit. If it is only a class period then students should stay in expert groups collect data for their parameter and share the data with the other groups as a class activity.

Assessment: Students can either write this in their journal or students can be randomly chosen to present to the class one of each the measurement parameters. In their description, they will describe 4 things:

- Explain what the factor is
- Explain why this factor is being measured.
- Explain the procedure for measuring the factor accurately.
- Predict what the measurement may be

Measurement Ideas

-
-
-
-

Group Names:

Assigned Water Test: _____

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Chemical and Biological Tests Chart (students write this in their journal to organize information for presentation to class)

What is Being Measured? Give examples	Procedure for Testing	Why is this important?

Potential Student Answers

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Use these references for background

1. http://streamsidescience.usu.edu/ou-files/ezplug/uploads/Whats_in_the_Water/SSS_Whats_in_the_Water.pdf

2. Streamside Side Science lesson plans pgs. 21-33(Water Chemistry) pgs. 39-53 (macroinvertebrate sampling)

Name of the Test	What is this factor being measured? Provide examples to help define	Type of Measurement (Notes to remember for how test will be done)	Why is this important?
pH	Measures how acidic or alkaline (basic) the water is. The pH scale is 0-14, 0= most acidic 14 most basic. Rain water low 5.6-6.0 Tap water neutral 7 Pond or lake 9	Color test, wait 1 minute	pH affects the function of membranes in living organisms, like the gills of fish, and aquatic insects acid rain,
Dissolved Oxygen (DO)	The concentration of O_2 molecules that are dissolved in water. Saturation decreases as water temperature or elevation increase Comes from plants, turbulence	Prepare sample wait for color development. Glass ampoule color test measured in mg/l	Fish and aquatic insects use for respiration Plants use oxygen during respiration Decomposition of dead organic materials uses oxygen
Turbidity	Measure of how much suspended material is in the water. Increases when water velocity increases. Land uses that disturb soil increase turbidity	Dip turbidity tube in stream fill to the top. Look down through the tube toward the target Black and white disc at the bottom. Record the water level in cm when you can see the tube. Use the chart to convert	Streams carry sediment naturally. If additional sediment occurs from eroded banks or changes in land use than the sediment may settle, cover and smother habitat for aquatic

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		cm to NTU's	insects or fish eggs.
Temperature	Measure of how much heat energy the water contains. Effected by season, geography, shade, shape of the channel.	Place thermometer in moving part of stream. Wait for temperature to stop changing about 1 minute. Record in °C °F	Many aquatic organisms have a specific temperature range to live. Many sport fish require cold temperatures.
Macroinvertebrate Sorting	Diversity tally of macroinvertebrates	Kick sediment downstream into a net Empty net into a pan or tub of water. Use a pipet to collect 100 aquatic insects using the sampling technique. Separate species into petri dishes. Use key to identify insects. Tally types of insects.	Indication of diversity of habitats within stream
Water Quality Index	Quantify macroinvertebrates by pollution sensitivity/tolerance	Transfer tally numbers of aquatic insects to Water Quality Index sheet. Multiply tallies by sensitivity value. Divide total number by number of insects to determine the Health of the Site.	Indicates water quality related to pollution
Algae (HAB-Harmful Algal Bloom)	https://www.livescience.com/54979-what-are-algae.html	Fill collection 1-2 collection containers with samples of water from just below	Too many nutrients in the water can cause algae populations to

		the surface. Return to class and view under microscope. Use Algae chart to identify type of algae. Report findings to NOAA site. If HAB's are present notify USU extension.	overpopulate (algal bloom) Some algal blooms (cyanobacteria) may produce deadly toxins that are harmful to humans, livestock, and pets.

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Name: _____ Group Name or Number _____
Date: _____ Site Name: _____

Site Observations:

Type of waterbody (e.g., stream, lake, wetland): _____
Weather today: _____
Weather yesterday: _____
Air temperature: _____
Water appearance (e.g., clear, brown, foamy, milky): _____
What type of land uses are in the immediate area? _____
What type of land uses are in the surrounding area? _____
Is the area shaded by trees? _____
List all other abiotic factors you can observe that might be important in this aquatic ecosystem:
_____
_____

Abiotic Factor	**Your Results**	**Utah allowable Range**	**What do the water measurements indicate about the water quality? What questions do I have?**
pH		6.5-9.0	
Dissolved Oxygen	ppm (mg/l)	Minimum of 6.5 mg/l for cold water fisheries and 5.5mg/l for warm water fisheries.	
Turbidity	NTUs	An increase of 10 NTU's from previous data	
Temperature	° Celsius	Maximum of 20° Celsius for cold water fisheries and the maximum temperature for water fish is 27° Celsius	
Nitrates	ppm (mg/l)	Nitrate concentrations of 4 mg/l in stream water are considered to be an indicator of pollution problems.	

Biotic Factors	**Your Results**	**Utah Allowable Range**	**What does this mean? Questions I have?**
Algae Types		No HAB's	
Macroinvertebrates (WQI)		>79 = excellent 60-79 = Good 40-59 = Fair <40 = Poor	

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Measurement Ideas

- Heat
- dirt
- size
- evaporate
- Chemicals pH acidity

Group Names:

- ~~Living or Non living~~
- ~~in or by~~

Assigned Water Test: pH

Measurement Ideas

- Height
- weight
- length
- Density mg/L

Group Names:

Assigned Water Test: Oxygen

5 1. Dip the thermometer into a moving part of the stream.

2. Wait for the temperature to stop changing (at least 1 min.

5 2. Read the temperture and record on the student worksheet.

$C° = 5/9 \times (F - 32$

$°F = [9/5 \times C°] + 32$

read first

What?	2 How measure?	3rd → Why?
Temperature	sticking a thermometer into the water for 1 min.	People know the heat and it effect the life cycle in the water.

1st What? first = Temperature
2nd How?= sticking a thermometer into the water for 1 min. Than explain
3rd Why? People know the heat & it effects the life cycle

Test name	What is being measured? examples	procedure	why is this important
Field Algae ID Guide HAB harmful Algal Bloom	The Algae in the Water	we will collect samples of the algae then id types under the micro scop	so it does not effect humans or animals