Understanding Water Quality Index Procedure and Tables

PROCEDURE

1. **Your group will determine the WQI for two unknown water samples by conducting a test for each of the nine parameters. Each member of the team will become the "resident expert" for one or more of the parameters listed in Table II: Water Quality Parameters. You will perform these same nine tests to determine the WQI of a stream when you visit a national park. In the interest of time and efficiency, the nine tests should be divided into four subsets, with one group member completing each subset.**
   - Dissolved Oxygen and Biochemical Oxygen Demand (your teacher will supply water temperature for this test)
   - Turbidity and Total Dissolved Solids
   - Nitrates and pH
   - Orthophosphates and Fecal Coliform
   - Temperature change (your teacher will supply the values for this parameter)

2. **Decide who will research each set of parameters. Research your parameters by reading the resource information provided by your teacher. Prepare a report to present to your team after research iscompleted. Your report should include answers to the following:**

   a. What parameters are you researching?
   b. What is the importance of each parameter?
   c. What are the acceptable levels?
   d. What units are used to measure the parameter?

TABLE II: WATERSHED WATCHDOGS PARAMETERS FOR DETERMINING WQI

Parameter	Importance	Acceptable Levels	Units of Measure
Dissolved Oxygen			
Fecal Coliform			
pH			
BOD			
Temperature Change			
Orthophosphates			
Nitrates			
Turbidity			
Total Dissolved Solids			

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3. **Gather materials and test your two water samples. (Note: Your teacher will provide your team with two 5-day old water samples to test BOD, two prepared fecal coliform plates, and two temperature change values to use in determining the WQI.)**

4. **Record test results in Table III: Water Quality Index for Unknown Samples.**

5. **Determine the Q-value for your test results by using the Weighting Graphs beginning on page 43 of the Teacher Resources. Record your values on Table III.**

6. **On Table III, multiply your Q-value by the Weighting Factor. Record the product in the TOTAL block. (Note: The weighting factor indicates the importance of each parameter to the WQI. You will note onTable III that parameters have been ordered according to their weighting factor.)**

7. **Share your parameter report and your test results with team members. As other team members report, record their test results on Table III.**

TABLE III: WATER QUALITY INDEX FOR UNKNOWN SAMPLES

	Unknown Sample 1 (Distilled Water)				Unknown Sample 2 (Pond, Stream, or Aquarium Water)			
Parameter	**Test Result**	**Q-Value**	**Weighting Factor**	**TOTAL**	**Test Result**	**Q-Value**	**Weighting Factor**	**TOTAL**
Dissolved Oxygen _____ mg/L Water Temp: _____ ° C		45	0.17			95	0.17	
Fecal Coliform		96	0.16			35	0.16	
pH		90	0.11			54	0.11	
BOD _____ mg/L of 5-day sample		98	0.11			11	0.11	
Temperature Change Water Temp: ____ ° C ____ ° C		92	0.10			73	0.10	
Orthophosphates		100	0.10			12	0.10	
Nitrates		97	0.10			27	0.10	
Turbidity		96	0.08			45	0.08	
Total Dissolved Solids		80	0.07			66	0.07	
	Overall WQI				**Overall WQI**			
	WQI Description				**WQI Description**			

Note: To calculate BOD, subtract DO in mg/L of the 5-day old sample from the DO in mg/L on the day the sample is taken.

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8. **Calculate the Water Quality Index for each sample by adding the values in the TOTAL column.**

9. **Use the Water Quality Index Interpretation Scale to describe the water quality of each sample. Record the descriptions in Table III.**

10. **The resident expert will share with other group member's information about the acceptable levels for and importance of his or her parameter. In Table IV on page 15, place a check in the appropriate box indicating whether the level of each parameter is acceptable or unacceptable.**

WATER QUALITY INDEX INTERPRETATION

WQI	Description
100 - 90	Excellent
89 - 70	Good
69 - 50	Moderate
49 - 25	Bad
24 - 0	Very Bad

TABLE IV: EVALUATION OF TESTS RESULTS

	Sample 1		Sample 2	
Parameter	Within Acceptable Levels	Outside Acceptable Levels	Within Acceptable Levels	Outside Acceptable Levels
Dissolved Oxygen				
Fecal Coliform				
pH				
BOD				
Temperature Change				
Orthophosphates				
Nitrates				
Turbidity				
Total Dissolved Solids				

11. **Choose two parameters whose values fall outside acceptable levels. Assume that the samples came from a freshwater stream. Suggest possible reasons for the unacceptable levels.**

Computing the Water Quality Index with Missing Parameters

Sometimes it's not practical or possible to collect or read a sample for the Fecal Coliform or Biochemical Oxygen Demand tests. In these cases, WQI results are skewed because the "Total" does not account for missing data. It is possible to adjust this score so that students can make an educated guess at what the WQI description should have been. Each parameter result has a maximum potential contribution to the overall stream score, and so one can adjust the total based on that potential.

Fecal Coliform accounts for 16% of the total result.
Biochemical Oxygen Demand accounts for 11% of the total result.

If you are computing the WQI without a Fecal Coliform result, follow this:
Divide your raw "Total" by 84 to get your adjusted "Total."

If you are computing the WQI without a Biochemical Oxygen Demand result, follow this:
Divide your raw "Total" by 89 to get your adjusted "Total."

If you are computing the WQI without either the Fecal Coliform OR the Biochemical Oxygen Demand results, follow this:
Divide your raw "Total" by 73 to get your adjusted "Total."

To check for correct math, the adjusted Total should be a greater number than the raw Total.

Weighting Graphs to Determine Q-Values

Q- VALUES: A MEANS OF WEIGHTING WATER QUALITY TEST VALUES

To develop the WQI, the National Sanitation Foundation selected 142 people who represented a wide range of positions at the local, state and national level. Through a series of questionnaires, each panelist was asked to consider 35 water quality tests for possible inclusion in an index. This number was finally reduced to the nine tests currently used.

The scientists were then asked to graph the level of water quality ranging from 0 (worst) to 100 (best) from the raw data for each of the tests. For example, for stream health, the best value for pH is about 7.4, so it is given a Q-value of close to 100. Low and high pH values do not support stream health and were given lower scores. The curves drawn by each scientist were then averaged to obtain a weighting curve for each parameter. Results of the nine parameters are compared to the curves, and a numerical value, or "Q-value" is obtained. These curves represent the best professional judgment of the 142 respondents to an arbitrary scale of water quality from 1 to 100.

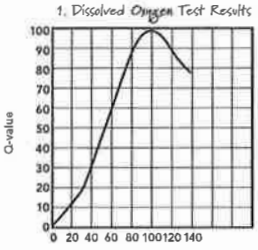
COMPUTE Q-VALUES FOR EACH PARAMETER AS FOLLOWS:

a. Find the weighting curve graph for your test.

b. Mark your test result with a pencil on the X-axis (horizontal) of the weighting curve graph.

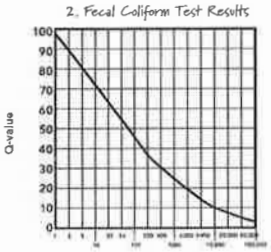
c. Draw a vertical line from that point to the weighting curve. Then draw a line from the intersection point on the curve to the Y-axis (vertical) of the graph. The point where your line intersects the Y-axis is the Q-value for your test result.

1. Dissolved Oxygen Test Results



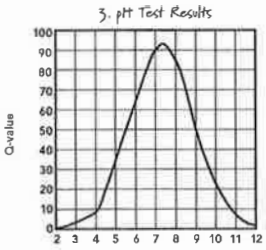
Dissolved Oxygen: % Saturation
Note: Q = 50.0 if DO% saturation >140.0

2. Fecal Coliform Test Results



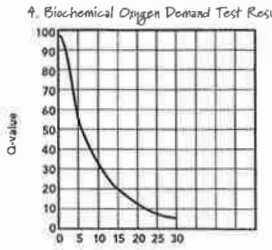
Fecal Coliform: colonies/100 mL
Note: Q = 2.0 if Fecal Coliform >100,000

3. pH Test Results



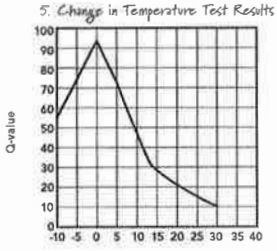
pH units
Note: Q = 0.0 if pH <2.0 or if pH >12.0

4. Biochemical Oxygen Demand Test Results



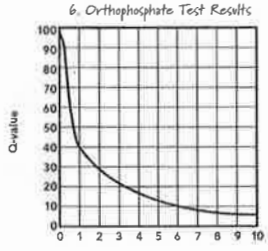
Biochemical Oxygen Demand (mg/L)
Note: Q = 2.0 if Biochemical Oxygen Demand >30.0

5. Change in Temperature Test Results



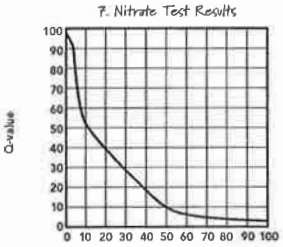
Change in Temperature (°C)

6. Orthophosphate Test Results



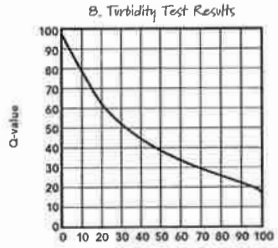
Orthophosphate (mg/L)
Note: Q = 2.0 if orthophosphate >10.0

7. Nitrate Test Results



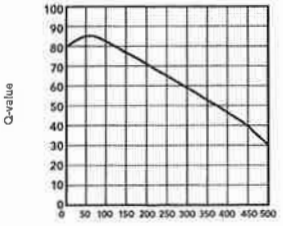
Nitrate (mg/L)
Note: Q = 1.0 if Nitrate >100.0

8. Turbidity Test Results



Turbidity (JTU)
Note: Q = 5.0 if Turbidity >100.0

9. Total Dissolved Solids Test Result



Total Dissolved Solids (mg/L)
Note: Q = 20.0 if Total Dissolved Solids >500.0