**Name**: Water Quality Testing of an Abandoned Mine Drainage (AMD) Impaired Stream
**Content** **area**: Environment/Ecology/Geology
**Grade**: 6-12

**Standards**:

* S7.A.2.2.2
* S8.A.1.1.1
* S8.A.1.1.3
* PA Environment and Ecology Standards

4.2.6 C

 4.2.6.D

4.2.7.F

4.2.7. D

 4.5.7.C

4.5.10.C

**Overview:** This lesson can be used as a stand alone lesson or combined with the Macroinvertebrate lesson, and or water quality of a clean steam.The lesson can involve students obtaining a water sample (ideal) or the teacher can obtain or make a sample to be tested. Students will test the water sample for a variety of parameters, and then interpret this data to determine if the water way sampled could support life.

**Materials**:

* “AMD Formation” Power Point lesson
* Clean plastic bottles for water samples, should hold at least 250 ml.
* Water Test Kit which included pH, alkalinity/acidity, and dissolved metals tests. (If unavailable see end of lesson for adaptations)
* Printed water quality worksheets for each student or group.
* Laboratory safety equipment including eye protection
* Thermometer

**Objectives**:

* TSWBAT identify and define pH, alkalinity, acidity, and dissolved metals.
* TSWBAT determine if a water body can support live based on water quality criteria.
* TSWBAT discuss human impacts on water quality.
* TSWBAT complete water quality tests using proper laboratory procedures

 **Set**-**Up**:

1. Present the AMD formation lesson to students.
2. If students will not be collecting water obtain AMD impaired water samples in clean plastic bottles and record temperature when they have been taken. If no source of AMD is easily accessible please see adaptations.

If students will be able to obtain their own provide them with plastic sample bottles have each student or team record the temperature of the impaired water when the sample is taken

1. Divide students into groups or pairs and review laboratory safety.

**Procedure**:

1. Have students test the pH, alkalinity, acidity, and dissolve iron content of their water sample following the instructions provided with the test kit, and enter these values into the water quality data sheet.
2. Have students compare their water sample to the DEP Chapter 93 standards provided on the worksheet.
3. Students should present their data to the rest of the class for comparisons and discuss if their water sample would support life based on the Chapter 93 Standards.

**Closure**:

1. Have students discuss the effects of AMD on each tested parameter to see how and why it affects life in streams.
2. Have students suggest possible solutions to this problem

 **Extensions:**

1. This lesson can be expanded to be taught as a weeklong procedure which would include macroinvertebrate testing and comparing two steams one impaired one non-impaired.

**Adaptations**:

 If a water test kit is unavailable for use, pH can be tested using red cabbage indicator. Directions for preparing this are available at <http://science.howstuffworks.com/innovation/everyday-innovations/experiment1.htm>

 If no test kit is available students can also complete the iron test. Mix a concentrated solution of baking soda and water. Mix 3 parts sample water with one part baking soda water. Compare sample the darker the orange color the more iron present. This does not give a mg/l reading as many test kits do but does allow for comparison.

 If AMD is not readily available in your area it can be created. To make AMD mix iron supplements (obtained from the vitamin section of your local pharmacy) with distilled water so the final concentration is approximately 10 mg/l of dissolved iron. If desired add sulfur (obtained from a garden supply store to the water) this will give the water a sulfur smell much like AMD. Finally adjust the pH using vinegar or other available acid to until it is approximately 3.