**Graphing Trends in Environmental Data**

**Alignment to Ohio Content Standards:**

[**Ohio Learning Standards for Science**](http://education.ohio.gov/Topics/Learning-in-Ohio/Science)**:**

**Environmental Science:** Pg. 107 ENV.ES.1: Biosphere-Biodiversity, Ecosystems (equilibrium, species interactions, stability)

**Environmental Science:** Pg. 108 ENV.ER.3 Water and Water Pollution. Hypoxia, eutrophication

**Environmental Science:** Pg. 108 ENV.ER.5: Wildlife and wilderness. Wildlife and wilderness management

**Environmental Science:** Pg. 108 ENV.GP.2: Potable water quality, use and availability

**Physical Geology:** Pg. 110 PG.IMS.4: Ocean. Streams (channels, streambeds, floodplains, cross-bedding, alluvial fans, deltas)

**Physical Geology:** Pg. 111 PG.ER.3: Water. Water quality, Hypoxia, eutrophication.

**Science Inquiry and Application**

* Identify questions and concepts that guide scientific investigations
* Design and conduct scientific investigations
* Formulate and revise explanations and models using logic and evidence (critical thinking);
* Recognize and analyze explanations and models; and
* Communicate and support a scientific argument

**Lesson Length:**

Two 40-55 minute classes

**Lesson Overview:**

Following an introduction to acid mine drainage, students will work in pairs to collect, graph and analyze data from local watersheds. Each group will be assigned one site to research an assigned parameter using Watersheddata.com. Students will create a scatter plot and then answer follow-up critical thinking questions in which they will be required to analyze and predict.

**Lesson Objectives:**

The student will:

* Define vocabulary associated with acid mine drainage
* Demonstrate ability to create scatter plot using data
* Compare zones of water near a treatment site
* Predict parameters of stream quality
* Summarize and relate data from watersheddata.com and student produced
* Create scatter plots

**Materials needed:**

* Timer
* Graph paper and ruler
* [Powerpoint](http://watersheddata.com/Education/Document/What%20is%20AMD%20Slides.pptx)
* [Student Worksheets](http://watersheddata.com/Education/Document/Parameter%20Vs%20Site%20Student%20Graph%20Worksheets.docx)
* [Answer Keys](http://watersheddata.com/Education/Document/Graph%20Answer%20Key.xlsx) and [Sample Graphs](http://watersheddata.com/Education/Document/Parameter%20Vs%20Site%20Student%20Graph%20Worksheets%20KEY.docx)
* [Access to Watersheddata.com](http://watersheddata.com/Default.aspx)

**Technology Needed:**

* Computers with internet access
* Microsoft excel (optional)

1. Engage the Learner

**Day 1:**

(2 minutes)

**Teacher (T):** Present students with a picture of an impaired river and ask students what is wrong with the river. (Slide 2)

**Student (S):** Share observations about picture presented.

2. Explore the Concept

**Day 1: Inquiry Based Learning**

(20 minutes)

**T:** Present students with question “What is Acid Mine Drainage?” (Slide 3)

**S:** Think-Pair-Share to answer the question. (5 minutes)

* Think (1 minute)
* Pair (1 minute)
* Share (3 minutes)

**T:** Present students with question “What causes AMD?” (Slide 4)

**S:** Think-Pair-Share (5 minutes)

**T:** Present students with question “What are the effects of AMD?” (Slide 5)

**S:** Think-Pair-Share (5 minutes)

**T:** Present students with question “Why should you care about AMD?” (Slide 6)

**S:** Think-Pair-Share (5 minutes)

3. Explain the Concept and Define Terms

**Day 1:**

(20 minutes)

**T:** Present slides 7-15 to students explain further details to each of the questions presented previously

**S:** Take notes on slides (15 minutes)

**S:** Exit Ticket students will independently answer the four presented questions (Slide 15). Students should answer each question with complete thoughts using complete sentences (5 minutes)

**Questions:**

* What is Acid Mine Drainage (AMD)?
* What causes AMD?
* What are the effects of AMD?
* Why should we care about AMD?

**Day 2:**

(5 minutes)

**T/S-** Review four main questions from Day 1. Teacher will ask for volunteers to provide a brief answer to each of the four questions (5 minutes)

**Questions:**

1. What is Acid Mine Drainage (AMD)?
2. What causes AMD?
3. What are the effects of AMD?
4. Why should we care about AMD?

4. Elaboration/Expansion of the Concept (remediation if needed)

**(Day 2)**

(40-50 minutes)

**T:** What can be done about AMD?  
**S-** Think for one minute and volunteer answers.  
**T:** Explain that students will be exploring stream conditions in an area being treated and demonstrate how to find data using watersheddata.com (Slide 16) (3 minutes)  
**T:** Explain activity and review scaffolding worksheet (5 minutes)

* Students groups will be assigned one parameter to collect data on from watersheddata.com (pH, Conductivity, Turbidity, etc.)
* Students will find and record a different parameter for the same site
* Students will create a graph using the parameter as the y-axis and river mile as the x-axis
  + Explain how to create a graph (Slide 17)
* Students will answer follow-up questions about their graphs
* Students will discuss if parameters seem related

**S:** Work with partner /group using watersheddata.com to collect information and create scatter plot. Students will create the graph using graph paper. (15 minutes)  
**T/S:** Each group should have a representative describe their graph to the class (5 minutes)  
**T/S:** Discuss trends across different parameters (Slide 18) (5 minutes)

**S:** Write a paragraph summarizing their results and parameter trends (Slide 19)

5. Evaluate Students’ Understanding of the Concept

* Collect Exit Ticket (Explore)
* Teachers should make observations about student understanding during discussions (Engage/Explore/Extend)
* Graphs and Data sheets (Extend)

Extension Activities:

1. Look at one site and compare different parameters over longer periods of time.
2. Compare parameters of sites that are being treated for AMD with parameters of sites that are not undergoing treatment.

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