**Seasonal Lake Turnover: Temperature and Water Mixing**

**Alignment to Ohio Content Standards:**

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

**Grade 7 Life Sciences:** Pg. 84 7.LS.1: Energy flows and matter is transferred continuously from one organism to another and between organisms and their physical environments.

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

**Environmental Science:** Pg. 107 ENV.ES.5: Movement of matter and energy through the hydrosphere, lithosphere, atmosphere and biosphere. Biogeochemical cycles, Ecosystems, Climate

**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. 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:**

50 to 60 minutes classes

**Lesson Overview:**

This lesson covers pond ecology and explains pond turnover events. Students will work together to investigate the question “Why are the fish dead?”. They will use the scientific method and put forth their thoughts as to why the fish die during the fall. Then, the teacher and class will discuss the actual reason which is pond turnover events and stratification.

**Lesson Objectives:**

The student will:

* Explain seasonal difference in pond’s primary productivity, temperature profiles, and dispersion of oxygen
* Explain how respiration fits into pond ecology
* Identify what causes fish kills
* Interpret diurnal graphs

**Materials needed:**

* [PowerPoint slides](http://watersheddata.com/Education/Document/Seasonal%20Lake%20Turnover_%20Temperature%20and%20Water%20Mixing.pptx)
* Case of the Dead Fish Dataset (Class Set)
  + <https://fw.ky.gov/Fish/Pages/Farm-Pond-Management-Water-Quality.aspx>
* Case of the Dead Fish Handout
* Case of the Dead Fish Example Answers
* Fish Kill Expert Sources (Class Set)
  + <https://woodlandstewards.osu.edu/sites/woodlands/files/imce/0008.pdf>
  + <https://aces.nmsu.edu/pubs/_w/W105.pdf>
  + <https://www.hobbyfarms.com/prevent-fish-kills-3/>
  + <https://pubs.ext.vt.edu/420/420-252/420-252.html>
* 360 Virtual Reality Photo for Virtual Reality Googles
  + Device used to view virtual reality 360 photos must have downloaded Google Street View app
  + Search “S Ridge Dr.” in Google Street View app
  + Correct photo is DCIM\100GOPRO by Watershed Ohio
    - This is not the actual location of the pond in the photo
  + If no virtual reality googles 360 photos can be accessed on Watershed Education [Virtual Field Trips](http://watersheddata.com/Education/Stream1.html)
    - Kelly’s Pond is correct image

**Technology Needed:**

* Virtual reality googles

1. Engage the Learner

(5 to 10 minutes)

**Teacher (T):** Begin lesson with 360 Pond Photo exploration. Ask students what they currently know about ponds. Follow questions on the slide (Slide 1) and allow students time to think about the answers and write an Entrance Ticket.

* What time of year is it?
* What are some of the organisms in the picture? Do you know their names?
* What would you expect to see in a pond?

**Student (S):** Answer questions on Entrance Ticket, then share out their answers about the pond.

2. Explore the Concept

(10 to 15 minutes)

**T:** Split students into pairs or small groups (2 to 4). Pass out one “Case of the Dead Fish Dataset” to each group, and give each student a “Case of the Dead Fish Handout”

**T/S:** Read the opening of the “Case of the Dead Fish” to the class, or have a student volunteer read the opening. Then read the vocabulary with the class as well, asking if anyone needs clarification of the terms.

**T:** Instruct the students to work in their small groups to answer what caused the fish in Mr. Water’s pond to die by using the datasets provided to make inferences. Have them record observation and answer the questions in their handouts.

* To support student Exploration and understanding of topics, consider giving them an article from https://fw.ky.gov/Fish/Pages/Farm-Pond-Management-Water-Quality.aspx

**S:** Use datasets to answer questions on handout and decide what killed Mr. Water’s fish.

3. Explain the Concept and Define Terms.

(15 to 20 minutes)

**S:** Share their observations and what they believed caused the fish kill.

**T:** Lead a brief discussion about the activity and ask students how they came to their conclusions.

**T:** Present PowerPoint about Seasonal Turnover Events (Slides 2-11)

**S:** Take notes on PowerPoint

**T:** Recap that the cause of the fish kill is Seasonal Turnover Events that causes dissolved oxygen to decrease, essentially suffocating the fish. (Slide 11)

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

(10-15 minutes)

**T:** Tell the students that now they know what is killing fish, they need to investigate ways to prevent turnover. Instruct them to work in their groups and use articles about turnover events to create a proposal for Mr. Water’s to prevent the fish death in the future. (Slide 12)

**S:** Research about possible solutions to prevent fish kills using expert sources provided by teacher and write a short paragraph proposal (one per group) for Mr. Water’s pond. (10 minutes)

**T/S:** Lead a class discussion, allowing students to share proposals and conduct general wrap-up of activity. Collect student handouts and proposals for proof of learning.(5 minutes)

5. Evaluate Students’ Understanding of the Concept

* Teacher should make observations during discussions to see student understanding (Engage/Explore/Explain/Extend).
* Teacher should collect Entrance Ticket, Case of the Dead Fish Handouts and the Fish Kill Prevention Proposals (Engage/Explore/Extend)

Additional Resources:

Kentucky Fish and Wildlife Website: <https://fw.ky.gov/Fish/Pages/Farm-Pond-Management-Water-Quality.aspx>