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| **TEAM Lesson Plan Template** |
| Teacher: Dr. Tom Blanchard |
| Subject/Grade: Biology |
| Lesson Title: Calculating Water Quality Values Using Macroinvertebrate Sampling |
| **STANDARDS** | **Identify what you intend to teach.** State, Common Core, ACT College Readiness Standards and/or State Competencies; Enduring Understandings and Essential Questions. |
| **BIO1.LS2.1** Analyze mathematical and/or computational representations of population data that support explanations of factors that affect population size and carrying capacities of populations within an ecosystem. Examine a representative ecosystem and, based on interdependent relationships present, predict population size effects due to a given disturbance. **BIO1.LS2.5** Analyze examples of ecological succession, identifying and explaining the order of events responsible for the formation of a new ecosystem in response to extreme fluctuations in environmental conditions or catastrophic events.Related Standards from mathematics: **7.SP.A.2** Collect and use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. *For* Crosscutting Concepts: Scale, proportion, and quantity (counting organisms), Systems and system models with defined boundaries (a stream ) SEPs: Analyzing and interpreting data, Using mathematics and computational thinking, Constructing explanations to explain phenomena  |
| **OBJECTIVE(s)/Sub-Objectives** | **Connect prior learning to new learning.** Clear, Specific, Observable, Demanding, High Quality, Measurable, Aligned to Standard(s), and Integrated with other subjects, build on prior student knowledgeStudent-Friendly (I Can Statement) |
| I can compute a water quality index from a sample of macroinvertebrates.  |
| **MATERIALS AND RESOURCES**  | **Content-related:** Clearly supports lesson objective(s); rigorous & relevant; Incorporates multimedia & resources beyond the textbook.  |
| **Activities & Materials** \_x\_ Computer, projector, screen/smartboard \_x\_ Sample of aquatic macroinvertebrates (AMI) (This could be an actual sample collected from a stream or a simulated sample using preserved specimens, flashcards, or images cut from the AMI\_Pics worksheet. This lesson plan is written assuming use of images from the AMI\_Pics worksheet. Modify as appropriate for other samples). \_x\_ WaterQualityIndex\_Worksheet and AMI\_tallysheet worksheet\_x\_ Dichotomous Key per group\_x\_ Webpage <https://www.macroinvertebrates.org/> (optional)\_x\_ Cutouts of AMI from AMI\_Pics.docx \_x\_ Calculator (optional) **What if the technology is not working?**If the projector is not working, 1) skip the webpage and 2) Use a pencil to emphasize the parts of the pictures of AMI that are hard to see (gills on mayflies, segments on leech, legs on water penny).If no calculator is available, do the computations by hand. **Routine for distributing materials** Place worksheets and sample of AMI on tables where groups will work.  |
| **ACCOMMODATIONS/ADAPTATIONS** | **Learning styles and interests.** Anticipate learning difficulties, regularly incorporate student interests & cultural heritage; differentiate instructional methods. |
| **Modifications/Plans for Diverse Learners** **Differentiation****--x--- Content** The number and variety of organisms in a simulated sample can be modified. As extreme examples, students who need a challenge may be given a sample that includes several of each type of organism on the WaterQualityIndex\_Worksheet, while students who are struggling may be given a sample with 3 leeches and two snails. **--x--- Process** Most students will use black and white photocopied pictures of AMI. Some students may need pictures with color or higher resolution. If so, let them look at images on a screen. **Accommodations****Prepare for individual students** |

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| **MOTIVATING STUDENTS/ANTICIPATORY SET** | **“Hook”: Engage students’ attention and focus on learning.** Personally meaningful and relevant. |
| Remind students that this lesson is part of a sequence to understand water quality. There were lessons on identifying AMI and assigning tolerance values. Now we will put these ideas together to get a measure of water quality. Show students a picture of a stream with good water quality and a picture of a stream with poor water quality.<https://en.wikipedia.org/wiki/Arkansas_River#/media/File:Arkansas_River_(2020).jpg><https://en.wikipedia.org/wiki/Water_pollution#/media/File:Nrborderborderentrythreecolorsmay05-1-.JPG> |
| **INSTRUCTIONAL PROCEDURES** | **Step-by-Step Procedures-Lesson Sequence: Basic to Complex.** Lesson includes visuals, modeling, logical sequencing and segmenting (beginning, middle, ending); essential information; concise communication; grouping strategies; differentiated instructional strategies to provide intervention & extension; seamless routines; varied instructional strategies; key concepts & ideas highlighted regularly. |
| For each group, print one copy of AMI\_Pics.docx. Cut out each image. Shuffle the images. Provide a set of shuffled images and the two worksheets to each group of students. ***Introductio*n** With the whole group’s attention, remind students about sorting macroinvertebrates using Dichotomous Keys. Point out that they will count types of macroinvertebrates and use the quantities to determine the quality of the water from which the sample was taken. Point out that some of the pictures are hard to see. Show one of the printed mayflies and show it on a screen. Without calling it a mayfly or calling them gills, point out the abdominal gills. Similarly, show a color screen image of the leech and point out its segments. Also point out the legs on the water penny. Tell students that each cutout represents one organism, even those that show a top and bottom view, or top and side view of the organism. Hold one of these up and ask students how many it counts as. Direct students’ attention to the AMI\_tallysheet. Explain that one student should record values on the sheet as the whole group identifies one organism at a time. They should pull the first picture from the top of the stack, identify the organism as one of the types on the tallysheet and make a mark. Watch to see if they perform this procedure correctly. Once it is clear that they understand, regain the whole group’s attention. Explain what they will do next. Direct their attention to the Water Quality Index worksheet. When they have counted all the organisms, they should count the tally marks on each row, and record this number in column A on the Water Quality Index Spreadsheet. They should then get a score for each row, multiplying the number of each type times the tolerance value on the sheet. Then they will add the values in columns A and C and divide the sum of column C by the sum of column A. They should record the quotient in the space provided and interpret this number as a water quality. Once they understand, have them return to the tally sheet and count the types of organisms. Observe their work and provide prompts or questions as needed. **Motivating Students** \_x\_ Verbal Reinforcement \_x\_ Relate to Real World: Water quality is important for drinking water and food chains **Presenting Instructional Content** \_x\_ Hands-On: Students are handling the samples\_x\_ Guided Practice: The worksheet and dichotomous key guide students through organism identification ***Instructional strategies:*****Modeling and Guided Practice *–*** Model how to count each card as one organism and how to make a tally mark. Have the students complete the tally sheet while watching them work, providing guidance as necessary.  **Check for Understanding (CFU) –** ***What am I doing for students that progress at different rates?*** Modify the number of organisms in a groups’ sample. If they are moving faster than other groups, provide more organisms for their sample. If they are falling behind, remove a few organisms. ***What do I do if they get it?*** Move on from a water quality level to asking students what could affect water quality and asking them about steps we can take to improve water quality. ***What do I do if they don’t get it?*** Reduce the number of types of organisms in the sample and talk students through the steps of the dichotomous key for each organism.  |
| **QUESTIONING/THINKING/PROBLEM SOLVING (embedded throughout)** | **Balanced mix of question types.** Utilizes Blooms Taxonomy/Webb’s Depth of Knowledge; high frequency; purposeful & coherent; require active responses; balance based on volunteers/non-volunteers, ability, & gender; lead to further inquiry & self-directed learning.  **Implement four types of thinking (Analytical, Practical, Creative, & Research-based) & Teach/Reinforce problem-solving types**. Provide opportunities for students to generate ideas & alternatives; analyze, evaluate & explain information from multiple perspectives& viewpoints. |
| **Questioning** **Knowledge:**Does the organism have jointed legs? Does the organism have abdominal gills? **Comprehension:** What is the water quality index for this sample? **Application:**Is the health of the water from which this sample was taken excellent, good, fair, or poor? What are some human activities that could lead to poor water quality? **Analysis:** The concept of biodiversity includes the idea of a stream having many different types of organisms living in it. Explain how changes in biodiversity would impact ecosystem stability and natural resources**Synthesis:****Evaluation:** **Thinking**\_x\_ **Creative**– Unless students go to a stream and collect samples themselves, they must imagine the AMI in the steam and collecting them\_x\_ **Analytical** – Students are comparing and contrasting features on the AMI to classify them. They are analyzing the quantities of each type to calculate the water quality index. **Problem Solving** **\_\_x\_ Categorization** Classifying AMI**\_\_x\_ Identifying Relevant/Irrelevant Information** There are many features on each organism. Which are relevant for classification. **\_x\_\_ Generating Ideas** Students are asked to identify ways to improve water quality |

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| **GROUPING** | **Maximize student understanding & learning** Varied group composition (race, gender, ability, & age); clearly understood roles, responsibilities & group work expectations; accountability for group & individual work; student opportunities for goal setting, reflection & evaluation of learning. |
| * Use heterogenous groups
* Group roles include Tally marker, Water Quality Index sheet recorder, Calculator, and Dichotomous Key flipper
* To assign roles, have students count off. Write the roles on a white board, and number them 1 through 4. Have students perform the role matching their number.
* Groups will complete a tally sheet and Water Quality Index sheet.
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| **ASSESSMENT** | **Formative and/or summative assessment.** A variety of assessments, including rubrics, measure achievement of objectives and informs instruction.  |
| **\_x\_\_Teacher Observation** The teacher will observe students work with the sorting and tally sheets. The teacher will also assess students’ verbal responses to questions about what affects water quality and steps to improve water quality.**\_x\_\_ Worksheet** The teacher will evaluate students Water Quality Index Worksheet**.**  |
| **CLOSURE** | **Reflection/Wrap Up.** Summarizing, reminding, reflecting, restarting, connecting. |
| ***Here is your exit ticket for today:*** Answer the question on a slip of paper: If we take a sample from a stream and find lots of leeches and no mayflies, is the water quality good or poor? ***Reflection: You must reflect on every lesson you teach.*** |

**NOTES:**

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