Lesson Plan: Remote Sensing of Water Quality

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Objective: To introduce students to the concept of remote sensing and its applications in monitoring water quality, specifically focusing on harmful algae. Students will engage in a coding activity to develop a statistical model correlating RGB values to chlorophyll-a levels in water samples. Students will then apply the statistical model to an image of Lake Mendota.

Duration: 1-2 class period (approximately 60-90 minutes)

Materials:

* PowerPoint presentation
* Camera (phone or computer)
* Computer and internet access
* Water quality samples with known chlorophyll-a levels

Procedure:

1. PowerPoint Presentation (15 minutes)
   * Present the provided PowerPoint covering the following topics:
   * a. Harmful algae bloom: causes and negative impacts.

b. Definition and principles of remote sensing

c. Solar radiation and the ways it can interact with a medium (water)

* + Briefly introduce the activity (last slide)

1. Coding Activity Explanation (5-10 minutes)
   * Explain the coding activity that students will be participating in using python and Google Colab, an open-source coding tool.
   * Describe the goal: to develop a statistical model that correlates RGB values of the four water sample images with their chlorophyll-a levels.
   * Students will need to create Google Colab accounts or access Google Colab from school google accounts.
2. Coding Activity (25 minutes)
   * Divide students into pairs or small groups (2-3).
   * Provide computers and open the code notebook (<https://tinyurl.com/MendotaRS>). Make a copy of the notebook to their personal account (File > Save a Copy in Drive).
   * Students create water quality samples in a 0.5 liter cup of water by adding chlorophyll following the table below:

|  |  |  |
| --- | --- | --- |
| Volume chlorophyll to add | # 3ml droppers | Chlorophyll-a (ug/L) |
| 1.5ml | 0.5 | 0.15 |
| 3ml | 1.0 | 0.17 |
| 15ml | 5.0 | 1.08 |
| 25ml | 8.3 | 2.85 |

Example Photos:



* + Instruct students to take pictures of each water quality samples using either a phone or computer camera. Try to make the background of each photo similar. Using a sheet of white paper with the concentration written on the background may be helpful.
  + Guide students in uploading photos and running the provided code.

1. Data Analysis and Conclusion (10 minutes)
   * Have Students complete part 1 (reading images and calculating reflectance) and discuss
     1. Touch base and make sure everyone could get to this point. Compare results.
     2. Discuss questions and how each group’s results differ
   * Have students complete part 2 and 3. analyze the statistical model and interpret the results.
     1. Talk about which models performed the best by R2 and which models make the most sense when compared to the original hypotheses.
     2. Discuss how the model translated to the image of Mendota and what limitations might exist for the model.
   * Encourage students to discuss the significance of their findings and any limitations or improvements that could be made.
   * Conclude the lesson by summarizing the usefulness and potential limitations of remote sensing in assessing water quality and its potential for environmental monitoring.

Homework:

* Questions are provided and can be answered in the coding document. Additional example questions are provided for discussion after if needed.