Water Quality

Numeracy Opportunities in Water Quality PBL (Grades K-12)

Regardless of grade level, students working with numeracy opportunities and demands will also be engaging in some/many of the guiding principles and standards for mathematical practices.

- **Guiding Principles:**
  - A clear and effective communicator
  - A self-directed and lifelong learner
  - A creative and practical problem solver
  - A responsible and involved citizen
  - An integrative and informed thinker

- **Standards for Mathematical Practice:**
  - Make sense of problems and persevere in solving them
  - Reason abstractly and quantitatively
  - Construct viable arguments and critique the reasoning of others
  - Model with mathematics
  - Use appropriate tools strategically
  - Attend to precision
  - Look for and make use of structure
  - Look for and express regularity in repeated reasoning

The following pages will provide you with information regarding naturally occurring numeracy opportunities focused on plastic pollution:

- **Childhood (K-5)**
- **Early Adolescence (6-8)**
- **Adolescence (9-diploma)**
- **Possible guiding questions**

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Childhood (K-5)

Math Focus Strands:

- **Quantitative Reasoning:**
  - **Measurements and Units::** Use appropriate measurement tools (e.g., test kits, sensors) to collect data.
  - Measure the temperature from different water sources, and in the case of ponds or lakes, from various depths.
  - Using student-built water filters, measure the flow rate through the filter based on the materials.
  - Using a daily water quality log to document clarity, pH, temp, salinity, dissolved oxygen, etc., for a period of time.
  - Estimate and calculate water use for daily activities (washing hands, brushing teeth, cooking, etc.)
- **Algebraic Reasoning:**
  - **Operations and Algebraic Thinking:**
    - Sorting water samples by specific characteristics (clarity, temp, pH, etc.)
    - Build a water filter and look for patterns and relationships based on the materials used in each layer.
    - Look for patterns and relationships between the locations where water samples are collected and the variables present at each site.
    - Use the above patterns and relationships to make predictions
    - Use data collected on water use for daily activities to calculate the amount used over a set period of time (week, month, year).
    - Students track water quality over a period of time to look for patterns and predict changes due to climate events
- **Statistical Reasoning:**
  - **Measurement & Data:**
    - Represent data from water use, water samples, filter experimentation, and water quality with charts and/or graphs
    - Survey students on their daily water use and represent the findings graphically.
    - Collect and analyze rainwater. Record results over time to look for patterns based on seasons and make predictions.
    - Collect data on the effects of single-source pollution (for instance, fertilizer causing algae blooms)
    - Students collect and analyze data from multiple water sources (tap, stream, river, lake, above a dam, below a dam, bottled water, ect) and show results graphically. Use the results to make predictions.

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Example Activities:

1. **Water Testing & Data Analysis** – Students collect and analyze real-world data.

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Early Adolescence (6-8)

Math Focus Areas:

- **Quantitative Reasoning:**
  - **Measurements and Units:**
    - Use appropriate measurement tools (e.g., test kits, sensors) to collect data.
    - Convert between different units (ppm, mg/L, mL, liters, etc.).
    - Understand scale, precision, and estimation when measuring.
  - **Rates & Ratios:**
    - Calculate water flow rates in rivers and streams.
    - Analyze ratios of pollutants to safe drinking standards.
    - Compare concentration levels between different test sites.
- **Algebraic Reasoning:**
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- **Geometric Reasoning:**
  - **Geometry**
- **Statistical Reasoning:**
  - **Statistics and Probability:**
    - Record, organize, and analyze data using tables, graphs, and statistical measures.
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Example Activities:

1. **Budgeting for Solutions** – Students calculate the costs of various water filtration options.
2. **Community Presentation** – Students use data visualization and argumentation to advocate for local water policies..

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Adolescence (9-diploma)

Math Focus Areas:

- **Algebraic Reasoning:**
  - Model relationships between pollution levels and human activity.
  - Predict changes in water quality over time using linear and exponential functions.
  - Create equations to represent trends in water contamination.
- **Statistical Reasoning:**
  - **Data Collection and Analysis:** Conduct water testing (pH, dissolved oxygen, turbidity, nitrates, etc.).; Record, organize, and analyze data using tables, graphs, and statistical measures.
  - Analyze probability of contamination events based on environmental and human factors.
  - Create statistical models to determine risk factors for water pollution.
  - Interpret trends using mean, median, mode, and standard deviation.
- **Geometric Reasoning:**
  - Map watershed areas using GIS or hand-drawn maps.
  - Calculate surface area and volume of water bodies.
  - Model the effects of runoff and erosion on landscapes.
- **Financial & Economic Literacy:**
  - Calculate costs of water filtration, conservation efforts, or cleanup projects.
  - Assess the economic impact of water pollution on local communities.
  - Compare costs and benefits of sustainable water management solutions.

Example Activities:

1. **Trend Modeling** – Students apply algebra and statistics to predict water quality changes.
2. **Community Presentation** – Students use data visualization and argumentation to advocate for local water policies.

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Alignment with Maine Solutionaries Framework

- **Systems Thinking** – Understanding the interplay between human activities, environmental policies, and water quality.
- **Critical Thinking & Problem-Solving** – Evaluating sources of pollution and designing mitigation strategies.
- **Collaboration & Civic Engagement** – Partnering with community organizations, government agencies, and scientists.
- **Innovation & Advocacy** – Proposing data-driven solutions for water conservation and pollution prevention.

Some guiding questions about water quality

Note: these questions might be good for all of the age ranges but might be answered differently by them.

1. How can we measure it?
2. What are some of the different issues pertaining to water quality?
3. Are water quality issues more local or more global?
4. What are some of the things that have been to address water quality concerns in the past? Are those measures still in place?