Plastic Pollution

Numeracy Opportunities in Plastic Pollution 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**

Plastic Pollution

Childhood (K-5)

Math Focus Strands:

- **Quantitative Reasoning:**
  - **Counting & Cardinality:** Counting types of plastic waste.
  - **Numbers and Operations in Base Ten:** Calculating total plastic waste collected over time.
  - **Numbers and Operations: Fractions:** Comparing recyclable vs. non-recyclable plastic.
- **Algebraic Reasoning:**
  - **Operations and Algebraic Thinking:**
    - Calculating total plastic waste for a week, month, or year.
    - Comparing wasted vs. consumed food portions.
- **Statistical Reasoning:**
  - **Measurement & Data:**
    - Weighing plastic waste using standard and non-standard units.
    - Creating bar graphs and pictographs to represent plastic waste categories and trends.

Example Activities:

1. **Plastic Collection & Sorting** – Students collect, categorize, and count plastic waste found in their environment.
2. **Graphing Plastic Waste** – Create bar graphs to visualize the most common types of plastic waste.
3. **Ratio of Recyclable vs. Non-Recyclable** – Compare how much plastic can be recycled vs. what goes to landfills.
4. **Estimation Games** – Predict how much plastic is used in a day and compare it to real data.

Plastic Pollution

Early Adolescence (6-8)

Math Focus Areas:

- **Quantitative Reasoning:**
  - **Ratio and Proportional Relationships:** Comparing plastic use before and after waste reduction efforts.
  - **Measurement & Unit Conversions** – Converting weights and volumes of plastic waste (grams to kilograms, liters to milliliters).
- **Algebraic Reasoning:**
  - **Expressions and Equations:** Modeling reduction rates of plastic waste over time.
- **Geometric Reasoning:**
  - **Geometry –** Estimating landfill volume occupied by plastic waste.
- **Statistical Reasoning:**
  - **Statistics and Probability:**
    - Determining the likelihood of plastics entering the ocean.
    - Comparing the prevalence of different types of plastic waste.

Example Activities:

1. **Plastic Waste Audits** – Students collect plastic waste data and analyze trends.
2. **Volume & Surface Area Calculations** – Estimate how much plastic fits into landfills vs. being recycled.
3. **Proportional Analysis** – Determine how plastic consumption per person affects pollution levels.
4. **Statistical Predictions** – Use past data to predict plastic pollution growth rates.

Plastic Pollution

Adolescence (9-diploma)

Math Focus Areas:

- **Algebraic Reasoning:**
  - **Creating Equations and/or Inequalities:** Modeling relationships between food waste reduction and economic savings.
  - **Reasoning with Equations & Inequalities:**
    - Modeling the long-term impact of plastic pollution reduction strategies.
    - Predicting plastic accumulation rates and possible mitigation effects.
    - Assessing the economic cost of plastic pollution and reduction strategies.
- **Statistical Reasoning:**
  - **Statistics & Probability: Interpreting Categorical & Quantitative Data:** Analyzing plastic pollution trends using measures of central tendency (mean, median, mode).
  - **Statistics & Probability: Making Inferences & Justifying Conclusions:** Examining the probability of microplastics entering the food chain.

Example Activities:

1. **Mathematical Models of Plastic Waste Growth** – Students analyze real-world data to create functions that model plastic accumulation over time.
2. **Cost-Benefit Analysis of Plastic Reduction** – Compare costs of different policies like plastic bans, recycling, and biodegradable alternatives.
3. **Regression Analysis on Plastic Pollution Data** – Identify correlations between plastic waste and environmental impact.
4. **Optimization Problems** – Develop the most cost-effective and efficient ways to reduce plastic waste.

Plastic Pollution

Alignment with Maine Solutionaries Framework

- **Systems Thinking** – Understanding how human activities contribute to plastic pollution. Understanding the consequences of plastic pollution.
- **Problem-Solving & Critical Thinking** – Using math to develop solutions to reduce plastic pollution.
- **Collaboration & Civic Engagement** – Presenting data-driven findings to local policymakers.
- **Innovation & Advocacy** – Using mathematical models to advocate for reductions and mitigation of plastic pollution

Some guiding questions about plastic waste and pollution

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

1. Measuring it
   - How can we measure it?
   - Volume? How might we do that?
   - Weight? How might we do that?
   - Can we say anything about the relationship between weight and volume?
   - Are there ideas other than measuring weight or volume?
   - What role might sampling play in helping us measure it?
2. Classifying waste
   - What classification schemes are possible?
   - (e.g., different kinds of plastic?; single-use vs reusable?; recyclable vs not recyclable?)
3. How does waste in the local area compare to state/national data?
4. What are some possible remediations and what % of plastic will these address? (e.g. recycling could address some but probably not all)
5. What are some already established ways to mitigate the problem of plastic waste?
6. What are the current options for reusing/recycling plastic waste?
7. What are some alternatives to using plastic? Do they also involve waste streams?
8. How is plastic waste different from other types of waste?