Climate Change

Numeracy Opportunities in Climate Change 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 climate change:

- **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:**
    - **Counting & Cardinality:** Counting occurrences of extreme weather events in a given year.
    - **Numbers and Operations in Base Ten:** Calculating differences in temperature over time.
    - **Numbers and Operations: Fractions:** Comparing sunny vs. rainy days or renewable vs. nonrenewable energy use.
- **Statistical Reasoning:**
    - **Measurement & Data:** Creating bar graphs and pictographs of climate-related data (e.g., average temperatures, rainfall).

Example Activities:

1. **Weather Data Collection** – Students track local weather for a month and create pictographs to represent patterns.
2. **Graphing Temperature Trends** – Students compare the average temperature for their town in different seasons.
3. **Counting Carbon Footprints** – Students count and categorize different activities (e.g., biking vs. driving) that contribute to CO_2 emissions.
4. **Fraction of Renewable Energy** – Students calculate what fraction of energy in their community comes from renewable sources.

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Early Adolescence (6-8)

Math Focus Areas:

- **Quantitative Reasoning:**
  - **Ratio and Proportional Relationships:** Comparing carbon footprints of different lifestyles.
  - **Measurement and unit conversions:** Converting energy units (kWh, joules, BTUs).
- **Algebraic Reasoning:**
  - **Expressions and Equations:** Modeling carbon emissions over time.
- **Geometric Reasoning:**
  - **Geometry:** Measuring the area affected by deforestation or rising sea levels..
- **Statistical Reasoning:**
  - **Statistics & Probability:** Analyzing trends in global temperature change and weather patterns.

Example Activities:

1. **Carbon Footprint Calculations** – Students measure their household's carbon footprint and compare it to national/global averages.
2. **Sea Level Rise Predictions** – Using past data to predict future increases in sea levels using linear functions.
3. **Proportional Analysis of Renewable Energy** – Students analyze the percentage of energy derived from different sources.
4. **Statistical Analysis of Extreme Weather** – Graphing changes in hurricanes, wildfires, or droughts over time.

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Adolescence (9-diploma)

Math Focus Areas:

- **Algebraic Reasoning:**
  - **Creating Equations and/or Inequalities:** Modeling climate-related trends with exponential and linear functions.
  - **Reasoning with Equations & Inequalities:**
    - Analyzing relationships between food waste reduction and economic savings.
    - Predicting food waste trends over time and proposing mathematical solutions.
    - Assessing the economic impact of food waste on businesses and communities.
  - **Financial Mathematics** – Evaluating the economic costs of climate change mitigation strategies.
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- **Statistical Reasoning:**
  - **Statistics & Probability: Interpreting Categorical & Quantitative Data:** Analyzing climate datasets using measures of central tendency and standard deviation.
  - **Statistics & Probability: Making Inferences & Justifying Conclusions:** Assessing the probability of extreme weather events based on historical data.
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- **Calculus Applications:**
  - Exploring rates of change in CO_2 emissions or ice sheet melting.

Example Activities:

1. **Mathematical Models of Global Warming** – Students use linear regression to model historical temperature trends.
2. **Cost-Benefit Analysis of Renewable Energy** – Analyzing the economic feasibility of switching to solar/wind energy.
3. **Regression Analysis of Greenhouse Gas Emissions** – Using real-world datasets to predict future climate change effects.
4. **Optimization Problems in Climate Solutions** – Designing the most cost-effective way to reduce carbon emissions using mathematical modeling.

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Alignment with Maine Solutionaries Framework

- **Systems Thinking** – Understanding how human activities contribute to climate change.
- **Problem-Solving & Critical Thinking** – Using math to develop solutions to reduce carbon emissions.
- **Collaboration & Civic Engagement** – Presenting data-driven findings to local policymakers.
- **Innovation & Advocacy** – Using mathematical models to advocate for renewable energy policies.

Some guiding questions about climate change

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

1. Noting data in a changing world:
   - What are trends in regional high temperatures?
   - What can we say about the frequency of extreme weather events?
   - What are the elevations of various global population centers?
   - What can we observe about changes in habitat range of various species?
   - Where can we observe actual rise in sea levels?
   - What is known about melting glaciers? Disappearing permafrost?