Addressing Middle School Science Teachers’ Conceptions of Climate Change

Tamara E. Peffer and Alec M. Bodzin, Lehigh University

Email: tep205@lehigh.edu
Web: www.ei.lehigh.edu/eli

Environmental Literacy and Inquiry (ELI)

Climate Change Knowledge Assessment

- Designed to assess climate change content knowledge levels
- 28 Multiple Choice items
  - Cronbach’s α = 0.809
- 3 open-ended response items
- Revealed initial knowledge deficits
- Climate and weather timescale differences
- Albedo effect
- Atmospheric composition and the role greenhouse gases play in climate change
- Specific trace gas influences
- Anthropogenic source contribution to climate change
- Relevance of water vapor to climate change
- Atmospheric vs. ground ozone
- Heat capacity concepts

<table>
<thead>
<tr>
<th>Pre-PD Climate Change Knowledge Assessment Example Questions (n=18)</th>
<th>Correct Answer</th>
<th>Incorrect Answers</th>
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</thead>
<tbody>
<tr>
<td>Q1 – Climate is defined as weather patterns that change on a scale of at least a few...</td>
<td>Decades (70.6%)</td>
<td>Years (17.6%), Months (5.9%), Weeks (5.9%)</td>
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<tr>
<td>Q3 – Which does not act as significant greenhouse gas?</td>
<td>Nitrogen (29.4%)</td>
<td>Water Vapor (58.8%), Methane (5.9%), Carbon Dioxide (5.9%)</td>
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<td>Q9 – Ozone existing in the lower troposphere is...</td>
<td>A pollutant created from the burning of fossil fuels (41.2%)</td>
<td>Beneficial to human and other life (52.9%), Made up of the most abundant element in the atmosphere (5.9%)</td>
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<tr>
<td>Q14 – Argon, carbon dioxide, and other trace gases make up approximately ___% of the earth’s atmosphere</td>
<td>Three (31.1%), Ten (12.3%), Five (6.3%)</td>
<td></td>
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<tr>
<td>Q16 – The three greenhouse gases that contribute the most to the total greenhouse effect are...</td>
<td>Carbon dioxide, water vapor, and methane (50%)</td>
<td>Carbon dioxide, ozone, and CFC’s (25%), Carbon dioxide, nitrogen and carbon monoxide (25%)</td>
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<tr>
<td>Q20 – Materials that absorb lots of energy without a large temperature increase have a...</td>
<td>High heat capacity (37.5%)</td>
<td>Low albedo effect (43.8%), High albedo effect (12.5%), Low heat capacity (6.3%)</td>
</tr>
</tbody>
</table>

Addressing the Issues

Who:
- 17 eighth-grade, urban middle school science teachers
- 1 pre-service intern teacher

How:
- Applied Geospatial Technological Pedagogical and Content Knowledge (GSTPACK) PD Model to ELI Climate Change Curriculum
- 3-day, 12-hour applied professional development series
- Embedded educative curriculum materials provide climate change content knowledge and pedagogical supports for implementation with diverse learners
- Teachers experience a sequence of inquiry-based laboratories, investigations with geospatial investigations and explorations, and web-based activities

Environmental Literacy and Inquiry (ELI) Activities Addressing Climate Change Misconceptions

Investigating Weather and Climate with Google Earth
- Earth Systems and Atmospheric Gases
- Heat Capacity Demonstration
- Greenhouse Effect Lab
- Investigating Albedo

Investigating Future Worlds with Google Earth
- Carbon Reduction Strategies
- Inventing Future Worlds with Google Earth