Argumentation and Assessment

- The significance of evidence-based arguments has been established as a central practice of scientists (Duggan & Gott, 2002) and learning science (Duit, Schweinberger, & Shouse, 2007), and now appears in the national standards (Achieve, inc., 2013).
- Large-scale assessments can impact teachers’ pedagogical approaches to instruction through efforts to align with the types of items included on the test (Britton & Schneider, 2007). Furthermore, classroom assessments can provide important information about student learning, which can then be used by the teacher to modify instruction (Bell, 2007).
- We currently lack valid and reliable assessments to measure students’ argumentation abilities (Osborne et al., 2004).

Arguments Across Multiple Modalities

- Argumentation, the process of constructing and critiquing an argument, is an authentic disciplinary literacy practice that can and should traverse the modes of reading, writing, and talking.
- One unique aspect of this work is its focus on assessing specific characteristics (constructs) of argumentation across multiple modalities (reading, writing, talking).

Quality of Justifications

- A scientific argument uses evidence to defend how or why a natural phenomenon occurs (Bartel & McNeill, 2012).
- A claim can be supported with different forms of justifications, including empirical evidence (McNeill & Krajcik, 2012), science ideas (Osborne et al., 2004), appeals to authority, personal story, plausible mechanism.
- A claim can be supported by one or more forms of justification, however some forms do detract from the more important forms.
- Student limits all of the justifications to the most important forms (e.g., empirical measurements and observations) OR
- Student provides more important forms as well as less important forms of justification, and the less important forms are used as additional support of the more important forms.
- Student provides more important forms as well as less important forms of justification, but the less important forms do not provide further support for or do detract from the more important forms.
- Student only provides less important forms of justifications (e.g., appeals to authority, personal story, plausible mechanism).
- Student does not provide any justifications.

Assessment Development

- We use the construct modeling framework from the BEAR Assessment System (BAS), which is comprised of four iterative steps: 1) construct, 2) item responses, 3) outcome space, and 4) measurement model (Wilson, 2005; Wilson, 2009).

Sample Writing Item

Aisha wonders what is related to the power of a volcano’s eruption.

On a field trip to a science museum, Dr. Martin tells Aisha that he studies large volcanoes from around the world. Aisha learns that the largest volcano on Earth is Mauna Loa, and that it is the newest of the volcanoes in the Hawaiian islands.

Figure 1. The Mauna Loa Volcano in Hawaii.

Aisha learns that the magma from some volcanoes has more gas bubbles and is thicker than the magma in other volcanoes. She also learns that the power of an eruption is related to the amount of pressure built up by the magma inside the volcano. The thickness of the magma and the number of gas bubbles in the magma affect how explosive the volcanic eruption is.

Aisha found the table below:

<table>
<thead>
<tr>
<th>Name of Volcano</th>
<th>Earth’s Average Surface Temperature at the eruption site</th>
<th>Power of Eruption (Scale 0 to 8)</th>
<th>Thickness of Magma</th>
<th>Number of Gas Bubbles in Magma</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>6°C</td>
<td>6</td>
<td>Sticky</td>
<td>Many</td>
</tr>
<tr>
<td>B</td>
<td>24°C</td>
<td>5</td>
<td>Sticky</td>
<td>Many</td>
</tr>
<tr>
<td>C</td>
<td>18°C</td>
<td>3</td>
<td>Sticky</td>
<td>Many</td>
</tr>
<tr>
<td>D</td>
<td>31°C</td>
<td>2</td>
<td>Runny</td>
<td>Few</td>
</tr>
<tr>
<td>E</td>
<td>12°C</td>
<td>1</td>
<td>Runny</td>
<td>Few</td>
</tr>
</tbody>
</table>

Aisha and her classmates need your help. Students in her class have different ideas about what is related to the power of a volcano’s eruption. Using the information Aisha learned about volcanoes, write an argument to Aisha’s class that answers the question:

What is related to the power of a volcano’s eruption?

When you are writing your argument keep in mind:
1) Justifying your claim with evidence and reasoning, and
2) Convincing Aisha and her classmates that your claim is stronger than other claims.

This research is funded by the Carnegie Corporation of NY grant B 8780.