Unpacking the dimensions entails gathering substantive information about how knowledge and skills are acquired and used in the domain.

### Design Process

1. **Unpacking**
   - Developmental stages:
     1. **Elicit ideas:**
        - Gather information from students using procedures relevant to the purpose of the activity.
     2. **Add ideas:**
        - Add ideas to the list.
     3. **Distinguish ideas:**
        - Distinguish ideas to ensure that the list includes distinct ideas.
     4. **Sort and classify ideas:**
        - Sort and classify ideas to group similar ideas together.

2. **Integrated Dimension Map**
   - The integrated dimension map describes essential disciplinary relationships and links them to aspects of the targeted practices and crosscutting concepts.

3. **Learning Performances**
   - Learning performances represent intermediate targets for curriculum and assessment design aligned with the PEL.

4. **Curriculum Activities**
   - Curriculum activities are aligned to the target PELs.

5. **Computational Model**
   - Computational models are used in the domain.

6. **Assessment Tasks**
   - Assessment tasks are aligned to the PELs.

### Research Questions

- How can a technology-enhanced curriculum unit that integrates science, engineering, and computational thinking help upper elementary students acquire proficiency in these disciplines along the three dimensions of the NGSS?
- What domain-specific supports do upper elementary students need to develop computational models of Earth systems and related engineering solutions?
- How can computational thinking be developed within the context of science inquiry and engineering design?
- How can the implementation of science curriculum materials integrating engineering and computational thinking be supported to enhance student learning?

### Design Perspectives

- **Evidence Centered Design (ECD)**, introduced by Mislevy & Haertel (1999), articulates how observable features of student performance provide evidence for students’ proficiencies and promotes coherence in the design of curriculum, learning technologies, and assessment.
- **Equitable design** (e.g., Lee, Quinn, & Valdez, 2013) enables design of curriculum, technology, and assessment that is accessible and fair to diverse student populations.
- **Informed engineering** (e.g., Burghardt & Hacker, 2006) focuses on the acquisition of design principles and constraints that require students to learn everyday engineering practices.

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**Table:**

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Example (Central Structures)</th>
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| Knowledge and skill | Essential knowledge and skill: Non-edited versions are added to the list.
| Proficiency boundary | Students are not expected to use edited versions.
| Prior knowledge | Students struggle to express terminating conditions.
| Equity considerations | When teaching conditional ideas, choose scenarios related to everyday experiences.

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**Implications:**

- A detailed domain analysis enables coherent integration of the science, engineering, and computational thinking disciplines.
- Learning performance statements enable the alignment of curriculum materials, learning technologies, and assessment to specific NGSS performance expectations.
- Assessment task design specifications help ensure that pre-post assessment tasks are appropriately aligned with the curriculum materials and that embedded assessments are informative to teachers.

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**Next Steps:**

- Score and analyze data from classroom pilot study underway (3 teachers and 18 science classes)
- Analytically assesses the relationship between the curriculum and computational thinking.
- Develop an approach for elementary teacher professional development to support students across science, engineering, and computational thinking.