Assessing Science Knowledge that Inextricably Links Core Disciplinary Ideas and Practices

Nancy Butler Songer
Professor of Science Education and Learning Technologies
Director, Center for Essential Science
The University of Michigan
Example of Tri-Dimensional Fused (Inextricably Linked) Knowledge

Core Disciplinary /Crosscutting
Because many animals rely on each other, a change in the number of one species can affect different members of the web.

Practice
Students build a complete scientific explanation consisting of a claim, two pieces of evidence and reasoning

Fused Knowledge
Students construct scientific explanations to address the question, How have recent changes in the Detroit River affected yellow perch populations?
Students *construct a scientific explanation* based on evidence about how greenhouse gas emissions and temperature have changed over time.

Students *construct an explanation* to address the question, Is there evidence that climate change will impact the distribution of the Red Squirrel?
Tri-Dimensional Fused Knowledge Learning Progression
Fused Knowledge Learning Goals are the Template for Curricular Units, Assessment, and Instruction

Fused Knowledge 3b. From Learning Progression

3b. Students *construct a explanation* to address the question, Is there evidence that climate change will impact the distribution of the Red Squirrel?

- Curricular Activities
- Assessment Tasks
- Instructional/Prof. Development Resources
How Do We Design Assessment Tasks Focused on Fused Knowledge?

Students *construct a explanation* to address the question, *Is there evidence that climate change will impact the distribution of the Red Squirrel?*
Step One: Cognitive Analysis and Strategic Simplification

Students construct an explanation to address the question, Is there evidence that climate change will impact the distribution of the Red Squirrel?
Example:
Intergovernmental Panel on Climate Change (IPCC) Future Scenarios

Scenarios for GHG emissions from 2000 to 2100 (in the absence of additional climate policies) and projections of surface temperatures.
Strategic Simplification of Aspects of (Content) Necessary to Support Students’ Ability to Construct Explanation or Prediction

<table>
<thead>
<tr>
<th>Future 1</th>
<th>Population growth rate</th>
<th>Energy use per person</th>
<th>Proportion clean energy</th>
<th>Total CO₂ emissions by 2100 (gigatons)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Fast</td>
<td>Low</td>
<td>Low</td>
<td>1862</td>
</tr>
<tr>
<td>Future 2</td>
<td>Slow</td>
<td>High</td>
<td>High</td>
<td>1499</td>
</tr>
<tr>
<td>Future 3</td>
<td>Slow</td>
<td>Low</td>
<td>High</td>
<td>983</td>
</tr>
</tbody>
</table>
Step 2: Create Stimulus Materials
Current Distribution of the Red Squirrel (real data)
Red Squirrel Distribution Under IPCC Scenario Future 1 (modeled data)
Red Squirrel Distribution Under IPCC Scenario Future 2

Focal Species Current and Future Distributions

Species...  
red squirrel (Tamiasciurus hudsonicus)  

<table>
<thead>
<tr>
<th>Species</th>
<th>Current</th>
<th>Future 1</th>
<th>Future 2</th>
<th>Future 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>red squirrel (Tamiasciurus hudsonicus)</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
</tbody>
</table>

Future 2 is ON, indicating the predicted distribution of the red squirrel under the given scenario for future 2.
Red Squirrel Distribution Under IPCC Scenario Future 3

Focal Species Current and Future Distributions

Species...
- red squirrel (Tamiasciurus hudsonicus)

Future 1: OFF
Future 2: OFF
Future 3: ON
Is there evidence that climate change will impact the distribution of the Red Squirrel?
Online Assessment Information Available for Teachers and Students in Real or Near Time
Summary Ideas

1. Our learning progressions are a series of fused knowledge statements organized into one of several possible sequences.

1. Our assessment constructs are fused knowledge statements.

1. Cognitive analysis leading to strategic simplification of some or all of the three dimensions of knowledge is necessary so that target audience can focus on generating fused knowledge.

1. Our curricular activities and our assessment tasks always focus on fused knowledge even as they variously provide support and fading of support appropriate for target audience.

1. Assessment items can be coded for either core disciplinary ideas, practices and/or fused knowledge (when appropriate).