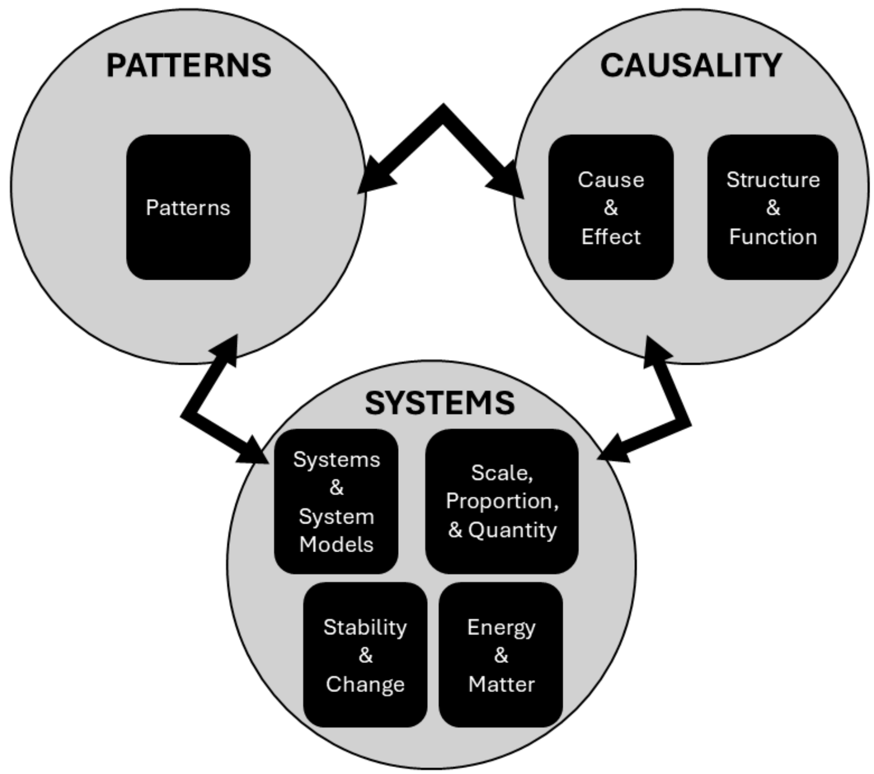
SOUTH CAROLINA
DEPARTMENT OF EDUCATION

Using Crosscutting Concepts in Elementary Science Classrooms

Organizing Crosscutting Concepts to Support Student Reasoning

One effective way to organize Crosscutting Concepts (CCCs) is by clarifying how they support students' conceptual understanding. As students investigate phenomena or problems, they identify patterns that help explain causes of changes in systems, especially in relation to matter, energy, stability, scale, and proportion. To support this approach, CCCs can be organized into three groups:

- **Patterns:** Young students are naturally good at noticing patterns. When instruction explicitly highlights the CCC of Patterns, students learn to use those patterns to help explain what they observe. Often, phenomena or problems are observable patterns.
- **Causality:** Helping students understand that explaining the causes of phenomena or problems. The CCCs of Cause and Effect and Structure and Function can guide students to think about how things are connected. be used to initiate student reasoning about relationships. These ideas help students make sense of what they observe and figure out how things work.
- **Systems:** Using systems thinking helps students break down a phenomenon or problem into parts they can explore. They can observe what is happening inside the system, how it connects to other systems, and what might be causing changes. These components are related to the CCCs of System and System Models, Energy and Matter, Stability and Change, and Scale, Proportion, and Quantity. These ideas help students make sense of how things work together.



The following general strategies support classrooms where CCCs are thinking tools that guide students as they observe, question, and explain the world around them:

- Use phenomenon-based instruction so students can observe and “figure out” as they move through the learning process.
- Develop a classroom culture of “figuring out.”
- Use CCCs daily to assist in “figuring out” phenomena.
- Use CCCs to guide class discussions and investigations.
- Connect CCCs across lessons to show their broad relevance.
- Ask students to apply CCCs to explain their thinking.
- Encourage CCC language in classroom discourse.
- Support student reflection on how they use CCCs to build understanding.

Building on these general strategies, teachers can support student use of CCCs as powerful thinking tools by tailoring their approach to each of the seven CCCs. The following section provides sentence frames and prompts for each CCC, offering practical ways to help students articulate their thinking, make connections across scientific ideas, and reflect on how CCCs shape their understanding of phenomena and problems throughout the learning process.

Patterns

Crosscutting Concept	Prompts and sentence frames to elicit student thinking about various phenomena/problems	Science and Engineering Practices that often align to the concept
Patterns Students notice when events or designs repeat. These patterns help them sort information, ask questions, and make predictions. In science and engineering, patterns are clues that help explain what is happening.	• What patterns did you notice? • Can you describe the pattern? • What predictions can you make based on the pattern? • What is the same? What is different? • What comes next? Does it repeat? • How do you know a ___ when you see one? What are ____ characteristics? • The pattern that I noticed is ____. • From the pattern ___ I predict ____ because ____.	• Asking Questions and Defining Problems • Analyzing and Interpreting Data • Using Mathematics and Computational Thinking • Obtaining, Evaluating, and Communicating Information

Causality

Crosscutting Concept	Prompts and sentence frames to elicit student thinking about various phenomena/problems	Science and Engineering Practices that often align to the concept
Cause and Effect Students observe that events happen for a reason. By asking questions and observing carefully, they can figure out what causes changes. This helps them understand how and why things happen.	• What happened? Why did it happen? • What is causing this to happen? • Can you make it happen again? • Can you show that this causes ___? • Can you identify the cause and the effect? • How can you show that this cause ____? • One cause of ____ might be ____. • ___ caused ___. The evidence to support this is ___.	• Planning and Carrying Out Investigations • Engaging in Argument from Evidence
Structure and Function Students observe how the shape and parts of an object or living thing help it do its job. By exploring these connections, they can explain how something works in nature or in things people build.	• How does the shape (or structure) of ___ make it work better? • What material is best to ____? Why? • How can this structure be improved? • What is the purpose of ___? • How is the structure related to the function? • The important structures of ___ are ___. • The [structure] of a ____ is for [function].	• Asking Questions and Defining Problems • Developing and Using Models • Constructing Explanations and Designing Solutions • Obtaining, Evaluating, and Communicating Information

Systems

Crosscutting Concept	Prompts and sentence frames to elicit student thinking about various phenomena/problems	Science and Engineering Practices that often align to the concept
Scale, Proportion, and Quantity Students use tools to measure size, time, and amounts. They compare measurements to understand how big or small something is and how changes in size or number can affect how something works.	• Which is bigger/smaller? How much larger/smaller? • Which is hotter/cooler? What is the difference in temperature? • Which happens faster/slower? What is the difference in time? • How long does it take? • How can you measure that? What tool and units will you use? • What measurement could you take? • ___ was (bigger/smaller/heavier...) than ____. • I used ____ units to measure because ____.	• Analyzing and Interpreting Data • Using Mathematics and Computational Thinking • Developing and Using Models
Stability and Change Students notice that some systems stay the same while others change. They ask questions to find out what causes change and what helps things stay steady over time.	• What is changing or staying the same? • Is the change slow or fast? Describe it. • How often does this change? • Do you notice a pattern to the change? • What could you change to make this better? • The system appears stable because ____. • I claim ____ is (changing/staying the same) because our evidence shows ____. • Over a long period of time ____ (changes/stays the same) because _____.	• Developing and Using Models • Constructing Explanations and Designing Solutions

Crosscutting Concept	Prompts and sentence frames to elicit student thinking about various phenomena/problems	Science and Engineering Practices that often align to the concept
Energy and Matter Students explore how energy helps objects move and systems work. They also track how matter moves and changes. Watching how energy and matter flow helps them understand how systems work.	• What are the properties of ___? • Do the properties stay the same? How are they different? • Can you break it into smaller pieces? • Can you put it back together again? How? • What is the weight before and after? • How was energy transferred? • How is the energy transferring in/out/within/between an object(s)? • I claim that [matter] changes because ____. • I noticed evidence of energy when ___ happened.	• Developing and Using Models • Constructing Explanations and Designing Solutions • Engaging in Argument from Evidence
Systems and System Models Students explore how parts work together within a system. They look at smaller pieces to understand how they connect and affect each other. By using models, students can show how the parts fit together and what the system does as a whole.	• What are the parts that make this up? • What do the parts do? • How do the parts work together? • Can you draw a model of the system? • What process is occurring? • Can you describe the system? • The system parts are ____. • The system parts such as ____, ____, ____ work together to ____. • In this system ___ interacts with ___ to cause ___.	• Developing and Using Models • Analyzing and Interpreting Data • Constructing Explanations and Designing Solutions • Planning and Carrying Out Investigations

Tips for Using Crosscutting Concepts

CCCs are essential tools that help students connect ideas across science disciplines and make sense of complex phenomena. However, their power lies in not just naming them, but in how they are used to support student thinking. When CCCs are embedded meaningfully into instruction, they become cognitive tools that guide students in observing, questioning, analyzing, and explaining the world around them. This requires intentional planning and consistent opportunities for students to engage with CCCs in varied and authentic contexts.

Teachers can support this process by modeling CCCs as reasoning tools, encouraging their use in discourse, and providing time for reflection on how CCCs shape understanding. When students are given repeated, authentic opportunities to use CCCs, they begin to see the concepts not as isolated ideas, but as powerful lenses through which to view and make sense of science.

To support this instructional shift, the following four approaches—**lenses, tools, bridges, and foundations**—offer practical and flexible ways to incorporate CCCs into teaching, learning, and assessment. Each approach highlights a different function CCCs can serve in the classroom and provides a pathway for deepening student engagement and sensemaking.

- **Lenses:** Using CCCs to deepen understanding of a phenomenon or problem and reveal new aspects to explain.
- **Tools:** Using CCCs to help clarify confusion and build on existing knowledge to create new explanations and ideas.
- **Bridges:** Using a CCC to connect different phenomena, problems, or units.
- **Foundations:** By using a CCC to establish common practices, language, purposes, or meanings, student learn when and why to apply CCCs.

Lenses: How does using a specific CCC help us see new things about this phenomenon or problem?	Tools: How can CCCs help us to make sense of a phenomenon or problem?	Bridges: How can the CCCs be applied to explain a new phenomenon or problem?	Foundations: Do we know when, why, and how to use the CCCs?
Supporting sensemaking: Focuses student thinking to support productive learning.	**Supporting sensemaking:** Expands and deepens student understanding of each CCC. Serves as a frame for “putting the pieces together” to explain phenomena or problems.	**Supporting sensemaking:** Strengthens the knowledge structures students build around science concepts.	**Supporting sensemaking:** Deepens student understanding of why CCCs are useful tools used by scientists to understand, interpret, and communicate.
Within instruction, look for: • Students incorporate CCCs into discussion and assessment responses. • Students engage in Science and Engineering Practices through the use of CCCs.	**Within instruction, look for:** • Students engage with diverse examples of and contexts for a CCC. • Students recognize when a familiar CCC is applied to a new context. • Students use CCCs to support deeper understanding of Disciplinary Core Ideas.	**Within instruction, look for:** • Students use a CCC at the beginning of a unit when encountering an anchor phenomenon and use the same CCC at the end of the unit to make sense of a new (analogous) phenomenon. • Students use a CCC as a common theme or concept that ties together different phenomena or problems.	**Within instruction, look for:** • Students co-construct the definitions of CCCs and how they are used to understand, interpret, and communicate. • Students have opportunities to discuss and/or reflect on which CCC(s) they used to make sense of something and why that particular CCC was useful.

Lenses: How does using a specific CCC help us see new things about this phenomenon or problem?	Tools: How can CCCs help us to make sense of a phenomenon or problem?	Bridges: How can the CCCs be applied to explain a new phenomenon or problem?	Foundations: Do we know when, why, and how to use the CCCs?
Within a task, look for: • The task driving question explicitly uses a CCC. • Explicit use of CCCs in prompts.	**Within a task, look for:** • Prompts use CCCs to scaffold sensemaking – either by requiring use of multiple CCCs and/or using one CCC at multiple levels of complexity.	**Within a task, look for:** • Students use a CCC as a common theme or concept that ties together phenomena or problems from instruction with the phenomenon or problem driving the task.	**Within a task, look for:** • Students have opportunities to explain and/or reflect on which CCC(s) they used to make sense of something and why that CCC was useful.

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