Evidence-Based Instructional Practices

Establishing the Learning Environment and the Kentucky Academic Standards for Science

The Establishing the Learning Environment Overview provides the research base associated with this evidence-based instructional practice.

What are connections between the Evidenced-Based Instructional Practice #1: Establishing the Learning Environment and the *KAS for Science*?

The *Kentucky Academic Standards for Science* identify what students should be able to demonstrate by the end of grade-level or grade-band instruction. The standards, written as performance expectations (PEs), are an integration of three different dimensions: disciplinary core ideas (DCIs), science and engineering practices (SEPs) and crosscutting concepts (CCCs). The DCIs are the conceptual content understanding of which students should have knowledge. The SEPs and CCCs are the dimensions that are used in service of the DCIs as students come to the conceptual understandings as they experience and actively engage with the sciences.

Science is a social and cultural construct in which students will interact with one another as they collectively explore and make sense of phenomena. In addition, science is often described as "messy." As a result, a level of trust between students and teachers, as well as between students, must be established. By establishing a safe and supportive environment, students can feel secure when engaging in that "messiness" as they interact with one another, exploring phenomena, designing solutions and overcoming perceived failures.

What might active engagement and messiness look like? After comparing maps showing a change in armadillo population distribution over the last 100 years, students investigate possible causes. As students work to understand this phenomenon, they may explore data about ecosystem changes due to climatic factors, resulting in the development of scientific arguments. As students share these arguments with one another, a safe and supportive environment is necessary such that students may critique and question data analysis and justifications for supporting a cause/effect relationship. These critiques may then lead to further investigation, which may lead to the identification of a different causal factor.

What are planning considerations for the successful implementation of the Evidenced-Based Instructional Practice #1: Establishing the Learning Environment to ensure that all students have equitable access and opportunity to learn the standards contained in the *KAS for Science?*

Students come to school with cultural differences of knowing and understanding.

- Educators can tap into student and community-based funds of knowledge in order to take advantage of these cultural understandings as students explore phenomena.
- Educators can utilize student and community interest in order to identify phenomena to investigate or engineering problems to solve. Collaborate with community members to

identify community wants and needs. Utilizing information from this collaboration, students can engage in citizen science projects in service of the community.
- Many second language students have rich family and community practices and histories. Recognizing these practices and histories, and leveraging them while interacting with students, can support students in their language development.

Science is about exploring and understanding the natural and designed world, both inside and outside of the classroom. Scientists come to understanding through scientific discourse, communication via spoken or written word. As students interact with one another in order to come to this understanding, it is important that they have a safe and supportive environment.

- Classroom layout is designed in such a way that students will be able to engage with one another as they employ sensemaking skills.
- Norms of participation, co-developed with students, support respectful discourse, which allows for meaningful sensemaking.
- As students are exploring and investigating phenomena, indoors or outdoors, listen to the questions that students are posing. These could be recorded on a driving question board for further exploration.
- The engineering design process is iterative. As such, students may feel a sense of "failure." Teachers can help students see that these missteps are a natural part of the engineering design process and redirect their frustrations towards exploring new approaches.
- When utilizing the outdoors, ensure students are aware of any potential hazards.

What strategies and resources can support the implementation of Evidence-Based Instructional Practice #1: Establishing the Learning Environment within the *KAS for Science?*

- To support productive discourse in the science classroom, teachers should implement co-designed norms and routines that support a safe learning environment as students make sense of phenomena or work to solve scientific problems.
    - The TeachingWorks Resource Library, from The University of Michigan, contains resources to assist teachers in the development of norms and routines in the science classroom.
- Determine the intersection between, and collaboration with, home and community.
    - The Kentucky Department of Education (KDE) professional learning module, Phenomena for Instruction, walks participants through a thought process that will engage student interest and community needs for lesson/unit development.
- These STEMTeachingTools briefs provide further strategies to support the establishment of a learning environment:
    - **How to build an equitable learning community in your science classroom:** Provides a number of classroom activities to help cultivate learning communities supportive for all students.
    - **How can formative assessment support culturally responsive argumentation in a classroom community?:** Provides strategies for fostering scientific argumentation that respects student culture, background and personal experiences.
    - **Connecting science instruction to neighborhood life through collaborative design with community:** Describes the connection between classroom, families and community, and how these connections can be leveraged to build relationships.

- **How to launch STEM investigations that build on student and community interests and expertise:** Describes the use of self-documentation as a method for identifying student or community interests that can guide instruction, thereby making the learning relevant.
- **Failing Forward: Managing Student Frustration During Engineering Design Projects:** Provides resources and strategies for helping students overcome frustrations that may be experienced during the investigative or engineering design processes.

Standards Family Guides

- The Kentucky Academic Standards (KAS) Family Guides have been developed to help families familiarize themselves with the content of each grade level's standards. Each guide contains a standards overview for Reading & Writing, Mathematics, Science and Social Studies and is available in English and Spanish.