Nevada Educator Performance Framework

A Guide for SCIENCE Educators

STANDARD 1	STANDARD 2	STANDARD 3	STANDARD 4	STANDARD 5
New Learning is Connected to Prior Learning and Experience	Learning Tasks have High Cognitive Demand for Diverse Learners	Students Engage in Meaning-Making through Discourse and Other Strategies	Students Engage in Metacognitive Activity to Increase Understanding of and Responsibility for Their Own Learning	Assessment is Integrated into Instruction

Standard 3: Students Engage in Meaning-Making through Discourse and Other Strategies

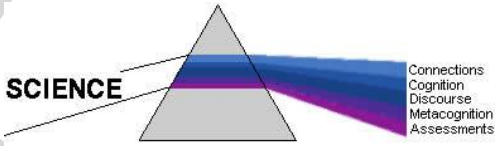
Indicator 1 - Teacher provides opportunities for extended, productive discourse between the teacher and student(s) and among students

Indicator 2 - Teacher provides opportunities for **all** students to create and interpret multiple representations

Indicator 3 - Teacher assists **all** students to use existing knowledge and prior experience to make connections and recognize relationships

Indicator 4 - Teacher structures the classroom environment to enable collaboration, participation, and a positive affective experience for **all** students

General Examples of Science Classroom Strategies:



- Emphasize the 3rd "E" - Explain
- Bring Models to Life
- Build Scientific Analogies
- Student-Centered Classroom

Key Ideas from Theory and Research:

- To engage students in active meaning making, students need to participate in discourse patterns in all domains, both orally and in written format (e.g., Jewitt & Ogborn, 2001). These discourse patterns include developing arguments, explaining, critiquing, using logic, and giving evidence to support or refute a claim (e.g., Halliday & Martin, 1993).
- Students' use of meaningful academic language has been shown to be much more prevalent in classrooms when teachers establish clear learning structures aligned with clear learning expectations and provide appropriate scaffolding for students (Quinn, Lee, & Valdes, 2012).
- Being able to understand and create representations is related to and may affect complex problem solving, transfer of knowledge to novel situations, and understanding of higher-level concepts (e.g., Greeno & Hall, 1997; Skemp, 2012).
- When students are engaged in learning processes which are driven by discourse about objects and ideas, they more effectively progress through increasingly complex states of conceptual understanding (e.g., moving from observations to modeling observations to then explaining and defending models) (National Research Council, 2011; Quinn, Lee, & Valdes, 2012).
- In science, for example, when students can spontaneously generate analogies for the scientific phenomenon they are learning, particularly in the process of overcoming misconceptions, their understanding greatly improves (e.g., Clement, 1989; Wong, 2006).
- Collaboration with peers encourages motivation and cognitive engagement. Collaboration involves working with others to obtain information, to share and discuss ideas and interpretations, and to receive feedback (Blemenfeld, Kempler, & Krajcik, 2006; Wentzel, 1997).

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Key Practice Examples for a Science Classroom:

Indicator 1 Example:

Ask students to engage in discourse early and often throughout a task

Ask students to actively engage, as lead facilitators, in inquiry-based, experimental design laboratory experiences such as the 5-E Instructional Model: Engage, Explore, Explain, Elaborate, and Evaluate. At each step along this journey, students are prompted to generate ideas, engage with successes and challenges, and work toward generating claims from evidence. The teacher encourages meaningful conversations that lead to student learning by employing fundamental ideas about productive discourse in classrooms, such as "priming" for different conversations, encouraging peer-to-peer talk, and different discourse moves (i.e. Probing, Re-Voicing, Pressing). The idea is to draw out students' understanding (preconceptions) of a phenomenon (e.g. a bicycle rusting in the yard) that is related to an important scientific idea (in this case chemical change or conservation of mass) and use that to plan the learning cycle. ***Discourse Moves (Teacher Tools):***

> ***Probing: What experience have you had with...? Can you tell me more about…?***
> ***Re-Voicing: So (name of student), what I hear you saying is that (air pressure has something to do with gravity)***
> ***Pressing: What evidence do you have for that claim? Why do you think that?***

Indicator 2 Example:

Ask students to create and interpret multiple representations

Ask students to create representations in their interactive science notebooks of the relationships among science concepts that will be presented in the lesson or unit. Students must be given opportunity to engage with science as a process of building descriptive and explanatory models of natural phenomena. In NEPF standard #3, focus is on students bringing these representations to life by engaging in discourse, verbally, written, graphical, and mathematical through the use of evidence to support their models. ***Example models:***

Bohr model of the atom	***Water cycle model***
Light ray model	***Computations models of the atmosphere***
Natural selection model	***Food web models & interactions between organisms***

*Modeling helps learners establish, extend, and refine knowledge that ***is enhanced*** by sharing and evaluating ideas through discourse.

Indicator 3 Example:

Ask students to make connections and recognize relationships

Ask students to generate explanations of relationships discovered using analogies. Analogies, like all models, have strengths and limitations. Therefore, careful attention must be paid to the degree of alignment between the discourse (verbal and written) to accurate scientific understanding and to where the analogy breaks down as discussions occur.

Target	Analogue
Electricity Flow	Water flowing in pipes (more like a bucket brigade: buckets of water pass from person to person that stop when the line is broken)
Function of Enzymes	Lock and key model (active sites that work with specific substrates)
Cycle of Rock Formation	Aluminum can recycling (moves through multiple processes)
Hydrogen Atom	Sports stadium (atom is mostly empty space)

Indicator 4 Example:

Teacher fosters classroom environment that enables collaboration and participation

Research shows the classroom environment established by the teacher affects student engagement and student learning. When a teacher allows students to make inquiries or set the stage for his or her academic success, learning becomes more productive. Moving along the continuum from teacher-directed (sage on stage) to student-centered (guide on side) promotes student motivation, affords peer communication, builds relationships, promotes discovery/active learning, and encourages responsibility for one's own learning.