SCALE
SYSTEM-WIDE CHANGE FOR ALL LEARNERS AND EDUCATORS

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Supporting Student Questioning in Scientific Reasoning

Stage of Questioning	Purpose of the Question	Example Questions	Teacher Moves to Elicit Questions
Awareness	Initial questions that activate prior knowledge and initiate inquiry.	Have I ever seen this before? Is this like a _____?	Present students with a discrepant event, intriguing scenario, or other natural phenomenon example. Prompt learners to develop and record the questions that come to mind. Pose questions like, "What questions do you have about how _____ is similar to something you have seen or done before?" Listen and observe to assess prior knowledge and/or misconceptions and use that information to adjust next strategies.
Informational	Focusing questions to guide further observations and descriptions or research.	What is happening? What do I see? What patterns do I see? What is causing this _____? Why are these different? Why does this happen? How does _____ act?	Prompt learners to explicitly identify the natural phenomenon and key concept(s) to be studied. Prompt learners to observe and describe or read and reflect, then record questions. Observe and listen to learners. Interact with learners (individually, small group, whole-class discussion), using probing questions and reflective listening to refocus listeners on the intended phenomenon or concept(s) as needed. Without providing solutions or answers, redirect student-to-teacher questions to learner-to-learner investigation when appropriate. Ask learners to make and record initial predictions.
Procedural	Organizational questions related to managing equipment, materials, and/or resources to gather evidence for the inquiry.	What materials are available to use for an investigation? What resources are available that might help me answer my question? How do I use this equipment to get the evidence that I need? How can I change the situation or set of materials to affect the action?	Present available materials explicitly. Solicit learners' ideas about additional materials when appropriate. Provide protocols. As learners design plans, consult with them to guide accurate recognition of what type and quality of evidence will likely be gathered by various procedures.

Outcome	Questions for which evidence must be gathered and information analyzed and synthesized to develop answers.	What is already known about this phenomenon? How does science explain this phenomenon? If _____ then will _____ happen? What is the affect of _____ on _____?	Refer learners to their initial observations and questions from which to build genuinely intriguing and scientifically oriented questions. Facilitate learner-centered discussions to develop criteria for determining if a question is scientifically oriented, relevant, and meaningful/valuable. Ask learners to justify and clarify their questions and procedures or research strategies to encourage rigorous questioning, logical reasoning, and appropriate evidence collection. Direct students to make predictions and/or formulate hypotheses based on previous observations and/or research.
Relationship	Application questions that guide further analysis and analogous understandings.	Knowing what I know about ____ how would _____ be similar or different?	Pose additional problems, situations, and opportunities with new situations for learners to apply or expand upon their developing conceptual understandings and/or skills. Direct learners to reference evidence and research from existing scientific bodies of knowledge when formulating explanations. Present learners with alternative explanations for comparison when appropriate.
Evaluation	Refocusing questions that guide students to characterize their understanding and/or assess a position.	How could I change my experiment to make it better? What evidence best supports my explanation? How does my explanation compare to others?	Ask open-ended questions about what learners think, and seek responses that include reference to evidence supporting their position. Observe and provide feedback as learners use and apply their new conceptual understandings and habits of thinking. Pose questions in which learners reflect upon the scientific habits of thinking that required for developing explanations. Provide opportunities for learners to reflect upon what has been learned and how.

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Outcomes and Evidence

By identifying the type of questioning that a student needs to engage in asking at the appropriate learning stage, teachers can support rigorous and logical question development that will result in

- learner engagement, evidenced by broader class participation and attentiveness,
- learner awareness of key concepts, evidenced by explicit identification of key concepts and appropriately aligned observations, descriptions, and/or research,
- scientifically oriented student-generated questions to guide inquiries, evidenced by the questions developed by students upon which investigations and/or research projects are based,
- scientifically oriented student-developed explanations, evidenced by explanations formulated with logic, reasoning, and evidence,
- metacognitive awareness of key concepts and scientific habits of thinking, evidenced by learners' self-reflections.

References

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