

Curriculum design: The 5-E Learning Cycle

The SAGUARO Project materials utilize the 5-E Learning Cycle model, which promotes student inquiry and exploration as a process for learning science. The Learning Cycle, originally credited to Karplus & Thier (*The Science Teacher*, 1967) and later modified by Roger Bybee for the BSCS project, proposes that learning something new, or understanding something familiar in greater depth, involves making sense of both our prior experience and first-hand knowledge gained from new explorations. The 5-E model divides learning experiences into five stages: Engage, Explore, Explain, Elaborate, and Evaluate. Each stage builds upon the previous as students construct new understanding and develop new skills.

Engage

This stage is designed to help students understand the learning task and make connections to past and present learning experiences. It should stimulate interest and prompt students to identify their own questions about the topic. Students explore the questions raised after they gain more understanding of the topic and the tools needed to investigate the ideas. Typical activities in this stage include posing a question, defining a problem, or demonstrating a discrepant event, then using small group discussions to stimulate and share ideas. To connect science to students' lives, we frequently use historical events, such as natural disasters, to stimulate curiosity and motivate learning. Instructors help students connect previous knowledge to the new concepts introduced in the unit.

Explore

In the Exploration stage students have the opportunity to get directly involved with the key concepts through guided exploration of scientific, geographic, economic, and other data sets. They begin identifying patterns in the data and connecting them to Earth processes. This further arouses student curiosity and new questions develop. Frequently, students will diverge from the slated activity to explore their own questions, continually building on their knowledge base. Through this process of questioning and exploration, students begin to formulate their understanding of the basic concepts. In this stage, instructors observe and listen to students as they interact with each other and the data sets. Probing questions help students clarify their understanding of major concepts and redirect their investigations when necessary. It is critical to allow adequate time at this point for students to thoroughly investigate the guiding questions in the module, as well as the questions they have generated themselves.

Explain

In this stage, students are introduced more formally to the lesson's science concepts. Through readings and discussions, students gain understanding of the major concepts and can verify answers to questions or problems posed earlier. In addition, more abstract concepts not easily explored in earlier activities are introduced and explained. As students formulate new ideas to interpret observations made in the Explore stage, appropriate vocabulary can be introduced. If students have unresolved questions, they may continue to look for solutions in the Elaborate stage.

Elaborate

In the Elaborate stage, students expand on what they have learned and apply their newfound knowledge to a different situation. They test ideas more thoroughly and explore additional relationships. Providing closure to the lesson and verifying student understanding is critical at this point.

Evaluate

The learning cycle provides opportunities for the instructor to continually observe students' learning and to monitor their progress using questioning techniques and discussions. More formal evaluation can be conducted at this stage. The assessment should be aligned with the styles and content of the learning experience. We have provided traditional assessments in the form of quizzes and ideas for alternative assessments such as using concept maps or having students create summary projects and reports. The multiple choice quizzes were designed and used primarily for assessing changes in student understanding as part of the evaluation of the materials.