Title
Accomplished Science Teaching: Building Student Understanding

Target Audience
This course is intended for pre-service and in-service science teachers, specialists, or coaches serving grades K-12.

Course Description
This course is the first in the Accomplished Science Teaching course series. The courses may be taken individually or as a series. This research-based course draws upon data from the National Board for Professional Teaching Standards’ performance assessment of science teachers. Through this course, learners focus on the evolution of student learning of science concepts. With an understanding of how science concepts build on each other, whether within a unit or grade or across grades, teachers can make well-informed instructional decisions and help students build their own understanding more efficiently. Several ideas in this course will be revisited in more depth in the other courses from the Accomplished Science Teaching series.

ATLAS Videos
The National Board aims to support teacher preparation by offering ATLAS (Accomplished Teaching, Learning and Schools). ATLAS is a unique, searchable online library of authentic videos showing National Board Certified Teachers at work in the classroom. Each video is accompanied by the teacher’s written reflection about the instruction or the activity shown. Aligned to professional teaching standards and indexed by teachers, ATLAS serves as a window into what accomplished teaching looks like. More than just a video library, ATLAS cases demonstrate Board-certified teachers’ approaches to teaching and to make their accomplished practice accessible.

ATLAS cases have been provided in this course to demonstrate accomplished science teaching and to serve as models of science instructional practices and strategies. These videos can be found in the course through the "Accomplished Teaching in Action" sections. They are not required course content, but are highly recommended.

Instructor/Facilitator
This course is facilitated by National Board Certified Teachers (NBCT) in Science.

Credits
Credits are determined by the college or university. The course was designed to be equivalent to a three-credit graduate level course.

Goals
By the end of the course, learners will
• understand the importance of defining science concepts rather than just facts that students should understand throughout their school careers;
• know the importance of recognizing and addressing students' weaknesses in prior knowledge, how misconceptions act as barriers to learning, and strategies for conceptual change; and
• know ways to assess students’ learning as they progress through their understanding of science concepts and development of science skills.

Session 1: Conceptual Understanding
Students must know the facts of science. However, without the proper concepts, the facts alone provide a very incomplete picture of scientific knowledge. This session is designed to introduce learners to the Architecture for Accomplished Teaching, developed by the National Board for Professional Teaching Standards, and to help them distinguish between factual and conceptual understanding in science. They will think about the distinction between a scientific fact and a scientific concept and identify some facts and concepts in a topic of their choosing. In this session, learners begin a final project, which they will work on throughout the course.

Learning Goals
- Understand the relationship between factual and conceptual scientific knowledge.

Evidence of Learning
1. Identify whether given science statements are factual or conceptual. (Activity 6)
2. Create a concept map for a science unit topic, including interconnections and relationships between and among topics. (Activity 8)

Session 2: Sequence of Concepts
This session provides some deeper understanding of the role of concepts in developing students’ science understanding. As this understanding is based on a number of experiences over a number of years, teachers can benefit from taking the time to consider what experiences students might have and how their understanding of one concept depends on their understanding of other concepts. Experiences and concepts that are appropriate for the students' current development are vital to successful science learning. Learners will read about learning progressions, sequences of concepts that build from basic understanding to more sophisticated understanding. They will analyze a given framework of standards to consider how concepts build across grade levels.

Learning Goals
- Understand that concepts build on other concepts over time: from year to year, or across grades.

Evidence of Learning
1. Discuss gaps in student knowledge that inhibit further learning. (Discussion)
2. Compare a district’s science scope and sequence for a particular topic in science with what is suggested in the Next Generation Science Standards. (Activities 3 and 4)
3. Begin to construct a conceptual sequence or learning progression for a science unit topic. (Activity 6)

Session 3: Planning a Unit Sequence
In the previous session, learners thought about a "year to year" science timeline. In this session, they will take a look at a shorter timeline: within a unit. Learners will take a look at the concepts that support student understanding of a big idea, namely "the reason for the seasons." They will consider what concepts are foundational and think about how to develop a careful sequence of these concepts across the grade bands.

Learning Goals
- Understand how conceptual understanding depends on a progression of subconcepts related to the bigger concept.

Evidence of Learning
1. Create a sequence of subconcepts that will support student understanding of a big idea in a science unit topic. (Discussion, Activities 3 and 4)
Session 4: Prior Knowledge, Misconceptions, and Conceptual Change

This session is designed to give learners the opportunity to examine the importance of recognizing and addressing weaknesses in prior knowledge in their students, how misconceptions act as barriers to learning, and strategies for conceptual change. Learners will read about strategies for identifying prior knowledge, for identifying and addressing misconceptions, and for bringing about conceptual change, and they will see a video about a student struggling to hold onto a common misconception. Learners will think more about what strategies might be used in the classroom and some approaches for implementing those ideas.

Learning Goals
- Know approaches to reveal students' prior knowledge.
- Understand how to elicit and confront students' misconceptions.
- Understand the importance of teaching for conceptual change.

Evidence of Learning
1. Name or describe strategies for identifying and addressing gaps in prior knowledge. (Discussion, Activities 6 and 7)
2. Describe methods for uncovering misconceptions in a specific topic. (Discussion, Activities 6 and 7)
3. Identify strategies that would be useful to help students overcome misconceptions. (Activities 3, 6, and 7)
4. Describe teaching strategies for moving students toward conceptual change. (Activities 3 and 7)

Session 5: Assessing Student Learning

This session is designed to help learners think about assessing students' learning as they progress to a more sophisticated scientific understanding. Learners will consider the role of assessment in science education and consider what information assessment items might show about student understanding. They will also look at some different assessment strategies and consider their benefits and challenges.

Learning Goals
- Understand the importance of assessing students' understanding and skills throughout a science unit.
- Know some strategies for assessing students' conceptual understanding in science.

Evidence of Learning
1. Reflect on current practice in assessment to determine its effectiveness. (Activity 2, Activity 3, and In the Classroom)
2. Identify various strategies for assessing student understanding. (Activities 4 and 5)

Session 6: Reflecting on Building Understanding

This session gives learners an opportunity to reflect on how they might use learning progressions and storylines in their science planning, and how to teach for and monitor students for conceptual change along that learning progression. Learners will also reflect on their work in the course and submit their final project.

Learning Goals
- Consider the process of planning a science unit through a broad learning progression to a unit content storyline, to provide students with conceptual change along the learning progression.

Evidence of Learning
Syllabus

1. Describe the benefits and difficulties of thinking about learning progressions, content storylines, and ways to address and monitor misconceptions and conceptual change in students' science understanding. (Activity 2)

Schedule
This course is scheduled to take approximately 45 hours to complete readings, activities, video, discussions, assignments, reflections, reviews, and a final project.

Requirements
Learners are expected to:
• Complete all assignments
• Maintain a reflection journal
• Participate regularly each week in discussion forums
• Ask for assistance when they need it
• Review and respond to facilitator feedback

Materials (hardware, software, plug-ins)
Technical Requirements:
• Word processor
• Internet browser with javascript
• High speed Internet service provider (for video viewing)
• E-mail
• Ability to view PDF documents

Evaluation
This course is evaluated on a letter grade basis, and may be available for graduate credit. See graduate credit details pertaining to specific graduate credit institutions.