3. Why should we use a concept-based curriculum design model?

- It develops structures in the brain (brain schema) for sorting, organizing, and patterning incoming information, and for transferring knowledge and skills through the conceptual level.
- It requires students to process facts and skills at a deeper intellectual level as they relate the facts, strategies, and skills to key concepts, generalizations, and principles.
- It engages and develops the intellect on two levels—factual/skill and conceptual.
- It supports "synergistic thinking"—the cognitive interplay between the factual/skill and conceptual levels of knowledge and understanding.
- It increases motivation for learning by engaging the personal intellect.
- It increases fluency with language as students explain and support their deeper understanding with factual information.

THE HOW OF CONCEPT-BASED CURRICULUM AND INSTRUCTION

Teachers can learn the principles of concept-based instruction and do a fine job—but their work is measurably eased if they have concept-based curriculum documents to support instruction. States, countries, schools, and organizations around the world are working to provide teachers with concept-based curricula. The Common Core State Standards and the Next Generation Science Standards are working to effect deeper conceptual understanding in classrooms across the United States. Individual states like Colorado, Ohio, Georgia, and Iowa are also working on three-dimensional curriculum frameworks for their academic standards. And organizations like the International Baccalaureate Programmes are based on a three-dimensional, concept-based model for curriculum and instruction.

Concept-Based Units: Interdisciplinary and Intradisciplinary

Interdisciplinary units of instruction look at a major topic, problem, or issue through the perspectives of different subject areas. Even two subjects, such as English and History, can make an interdisciplinary study—as long as there is a conceptual level of work involved. This is one reason that we recommend using a conceptual lens to focus each unit of study. When a unit does not have a conceptual level of work involved, we would consider it *multi-disciplinary* rather than *interdisciplinary.* It is the conceptual lens, or a conceptual level of work, that

It is the conceptual lens, or a conceptual level of work, that *integrates* thinking.

integrates thinking by facilitating conceptual syntheses from the interdisciplinary connections. The International Baccalaureate refers to "Key Concepts," which equates to what we term *Conceptual Lenses*.

Perhaps the best way to convey our experience and current thinking on the design of concept-based interdisciplinary units would be to address a set of questions on the topic:

1. What is the value of interdisciplinary curricula and should all curricula be designed in this fashion?

Elementary Grade Levels. Interdisciplinary units are common and viable at the elementary school level because the depth of knowledge and understanding is not as great as required in secondary school levels. Interdisciplinary units at the elementary school level help students see the interconnections of knowledge and understanding, give them opportunities to learn about concepts across the disciplines, and develop breadth of understanding. There must be additional blocks of time during the school day to address literacy skill development in English language arts and mathematics, however, in addition to their applications in interdisciplinary units.

Secondary Grade Levels. Interdisciplinary units at the secondary level provide wonderful opportunities to explore the relationships and perspectives of different disciplines on a topic under study. For example, a unit on the Holocaust lends itself well to the perspectives of history, literature and media, and the arts. There are cautions, though, in attempting to approach ALL school curricula in an interdisciplinary fashion:

a. To be literate in a subject, students need to have depth of conceptual understanding supported by factual content and skills. In interdisciplinary units, some subjects do not get in-depth treatment of their critical conceptual understandings because they are serving more of a supportive role to the main unit topic.

b. Every discipline has a unique conceptual structure. That is, mathematics concepts are different from humanities concepts and art concepts. We have distinct disciplines for a reason. At the secondary school levels, students are immersed in the language and learning of disciplinary studies to gain greater depth of knowledge, skills, and understanding.

c. As long-time curriculum writers, we know that an attempt to create fully interdisciplinary curricula at the secondary level would destroy the conceptual structure of the different disciplines. This would lead to a weak, unarticulated curricular program for a school.

2. How many interdisciplinary units of instruction would be appropriate for a year at the secondary school level?

It depends on the ability of the unit topic to provide participating subjects depth of treatment for their respective concepts. Generally, one to three quality interdisciplinary units in a year would be workable without sacrificing disciplinary integrity.

3. What about "integrated subjects" like Integrated Mathematics, or History/English collaborations?

Notice that Integrated Mathematics is still within the discipline of mathematics—and this works well. When teachers collaborate to offer a block of History/English, or Mathematics/Science the curricula have been carefully matched so they reinforce each other while maintaining disciplinary integrity. This also can work well, but again, be cautious not to shortchange one or the other discipline. Of course, mathematics needs to be applied to real-world contexts to fulfill the purpose for which it was designed—to explain phenomena in the world, to solve problems, and to create new paradigms.

4. Is there a difference between "integrated" and "interdisciplinary?"

Integration is a *cognitive process* that occurs when students rise above the factual content of a study and "integrate their thinking" at the conceptual level. This means that they have processed the factual information through the conceptual mind (synergistic thinking) and have reached a synthesis of knowledge and understanding. This integration of thinking leads to a statement of conceptual understanding that is supported by the facts, and that ensures the ability to transfer the understanding through time, across cultures, or across situations. Concept-based units, whether inter- or intradisciplinary, are "integrated" if they have a conceptual level of work that ensures the integration of thinking.

Integration is a cognitive process that occurs when students rise above the factual content of a study and "integrate their thinking" at the conceptual level.

5. Why is a Unit Web a very helpful tool in the design of interdisciplinary units?

We strongly advocate that teachers begin unit planning with a concept/content overview web. This allows them to identify the unit title, the conceptual lens, the strands to be addressed, and the critical topics and concepts. Thinking through the "whole" or "big picture" of the unit before addressing the parts results in a well-thought-out unit.

6. What is a common error often made in the design of elementary grade level interdisciplinary units?

Interdisciplinary units need to value the concepts and conceptual understandings of *each* subject brought into the study. In too many cases, however, subjects like art or physical education end up being activities with no conceptual understandings drawn from students. If we bring art activities into a unit, then we should be drawing students to a conceptual understanding of the relationships between the elements and principles (conceptual understandings) related to the art activities. For example, in a primary grade unit on *My Family*, students are often asked to "draw your family." But what concepts of art could be taught? Line, shape, form? And what would we want students to understand conceptually about these concepts? Perhaps the idea that "Lines can be drawn to suggest the shape and size of objects." The same caution—to address conceptual understandings—applies to physical education or any subject brought into an interdisciplinary study.

7. How do we address the burgeoning amount of factual content in the different disciplines?

Concept-based instructional units, whether inter- or intradisciplinary, are idea-centered rather than coverage-centered. Curriculum designers give a great deal of thought to crafting the most important conceptual understandings to focus the inquiry for learning in each unit. It is impossible to know all information because it is expanding exponentially. So it just makes sense to select content that best illustrates the important concepts and conceptual statements of understanding in each discipline. Because conceptual understandings (generalizations) transfer, we provide students with the understandings to help them see patterns and connections to other examples of the same ideas.

Concept-based instructional units are idea-centered rather than coverage-centered.

8. How do we assure teachers that students will score well (even better generally) on assessments using a concept-based unit design model?

We have received feedback from concept-based school districts over the years (in addition to our personal experience in watching test scores rise) verifying that, indeed, test scores on standardized tests and external assessments have risen significantly after shifts to a concept-based model. Why would this happen? It is easy to reason—students who are invited to think with their own conceptual mind as they work with factual and

skill-based curricula will of necessity process the content at a deeper level in their brain. They will need to think more deeply to discern the relationship between the conceptual lens or conceptual question(s) and the factual support. This deeper cognitive processing helps students retain information longer in addition to gaining a deeper understanding.

Intradisciplinary units of instruction are designed to build conceptual depth of understanding within a particular discipline. For example, an intradisciplinary science unit on Chemical Bonding, or an algebra unit on Linear Equations and Functions is common in secondary schools. Certainly, however, the concepts that are being learned in these intradisciplinary units should be applied to real-world examples to realize the relevancy. Also it is important to understand that the generalizations developed for an intradisciplinary unit have transferability across other examples *within* the subject area or discipline. (Transferability does not only apply across subject areas.) For example, if I have learned from the unit on Chemical Bonding that, "An ionic compound/bond may be formed when a force is created by the displacement of electrons from one atom to another," I can transfer that understanding across a multitude of specific examples within chemistry.

Assessing for Deep Understanding

Recently, national and international standards have stressed procedural and conceptual understanding that prepares students for college and career success. These standards also support student creativity, communication, and collaboration—and promote transfer of learning. Changing assessments allow students to respond in an inquiry setting and discover solutions across a variety of situations.

There are two assessment groups in the United States currently working to develop technology-based systems to assess the Common Core State Standards for English and Mathematics. The first, Partnership for Readiness for College and Careers (PARCC), a twenty-two-state consortium, includes custom items and tasks aligned to the Common Core State Standards for English language arts/literacy with authentic texts worthy of study rather than artificially developed passages. The reading questions on PARCC assessments are sequenced to engage students more deeply with texts rather than a random set of questions of variable quality. For mathematics, PARCC assessments will include worthwhile problems involving multi-step solutions, conceptual questions, practical applications, and robust procedures. A strong focus on the mathematics Common Core expectations will reinforce conceptual depth rather than a coverage of disconnected topics.

The second group, The Smarter Balanced Assessment Consortium, is also developing a system of assessments aligned to the Common