

<b>Knowledge-Centered 2: Conceptualizing &amp; Generalizing</b>		
1	Title Slide	Welcome to this module, Conceptualizing & Generalizing, in the Knowledge-Centered teaching series. To advance to the next slide, select the “forward” arrow located on the play bar at the bottom of your screen.
2	Introduction	In the last module, we discussed the importance of emphasizing depth over breadth in instruction. This is because teaching for depth enables students to learn more about the key concepts – or “big ideas” – of a subject or discipline (NRC, 2000). Knowledge-centered environments enhance students’ abilities to understand and solve problems when opportunities are provided for students to organize their own knowledge.
3	Learning Objectives	By the end of this module, the learner will be able to incorporate strategies into their classrooms to develop students’ abilities to conceptualize and generalize.
4	Conceptualize	<p>According to Webster’s dictionary, to conceptualize means to form an idea about something. In order to develop students’ abilities to conceptualize, teachers must take students’ prior understandings of content to be taught and present them with opportunities to build upon or challenge their prior understanding. James Minstrell, a high school physics teacher, paints a visual of this process by comparing student’s prior understandings to strands of yarn – some unconnected, some wound together loosely. Instruction helps students unravel individual tangled strands of beliefs, gives the strand a label, and then weaves the strand into a fabric to complete the understanding (Minstrell, 1989: 130-131). Rather than cutting the student’s tangled yarn and starting over, teachers help students differentiate and build upon their beliefs to be more like the beliefs of scientists.</p> <p>In order to fully conceptualize information, students must have the opportunity to develop a deep understanding of subject matter in order to turn their existing knowledge base of factual information into usable knowledge and understandings.</p>
5	Conceptualize	<p>Before students can learn new information in science, they need to re-conceptualize misconceptions they have that might interfere with learning. Whether they realize it or not, people spend a considerable amount of time constructing their view of the world through their observations and experiences, and not all these observations or experiences are congruent with scientific concepts. Existing knowledge about a subject can make it difficult to understand new information.</p> <p>For example, in a study of how elementary through college students perceive the role of soil and photosynthesis in plant growth, it was found that while students in higher grades displayed a better understanding of the concepts, all grade levels exhibited several misconceptions (Wandersee, 1983). Some of those misconceptions included that soil is the plant’s food, plants get their food from the roots and store it in their leaves, and that chlorophyll is the plant’s “blood.” Students in the higher grades had already studied photosynthesis, yet</p>

		<p>their formal education of the concept led to several serious misconceptions. Perhaps this could have been resolved if students were probed for their preconceptions before being presented a sophisticated explanation of plant systems (NRC, 2000).</p> <p>According to the National Research Council, since “learners construct new understandings based on their current knowledge,” direct instruction practices such as lecturing should only be used under the right circumstances. This is because misconceptions can easily be taught if students’ learning is not made visible in order to remedy defective conceptions.</p>
6	Bridging	<p>Assessments, especially formative assessments, help teachers to identify their students’ prior misconceptions. We will discuss how assessments accomplish this in a later module, but for now let’s talk about how instructional strategies can aid teachers in identifying and overcoming misconstructions of knowledge.</p> <p>One instructional strategy that teachers can use to help students overcome prior misconceptions is through “bridging.” This strategy attempts to bridge the gap between students’ correct beliefs, which are called anchoring conceptions, to their misconceptions through presenting a series of similar situations. This type of probing helps students come up with ways to resolve conflicting views and also guides students to construct an intelligible viewpoint that is applicable in other contexts (NRC, 2000).</p> <p>The bridging strategy begins with a scenario in which the teachers know the students have misconceptions. The example provided can show how bridging can help students understand the importance of classifying kingdoms.</p> <p>First, the teacher will present the bridging activity. Working in pairs, students are given a worksheet with different models and makes of cars, including sports cars, minivans, trucks, sedans, and are asked to rank the vehicles in order from most desirable to least desirable. Time was allotted to students so that they could discuss their rankings with each other. Next, the teacher will fully activate the bridging question by asking students to come to the board to discuss and defend their rankings. During this time, the teacher should be mentoring students to notice that classification is based on random choice or preference, and that an object or idea may be classified in more than one category.</p> <p>In a second worksheet, students will be given depictions of different kinds of organisms and are asked to group them into two groups, then five groups, and then 12 groups. During this time, the students are reminded about the rules set previously. Now that the students have created their own understanding of the classification of organisms, they are ready to bridge to more abstract science concepts. They have done this by starting with the common example of cars and then bridged to the scientific concept.</p>
7	Analogies	<p>In addition to bridging misconceptions through situations, Brown &amp; Clement’s (1989) bridging analogies strategy starts by the instructor making misconceptions clear by using a target question for students. Then, the</p>

		<p>instructor suggests a case that is analogous to what the students believe, also known as an anchoring example. It is important to note that even though a student might properly reason about the anchoring example, the student might not believe the analogy has a valid relation to the target case. It is then the job of the instructor to attempt to establish the analogy relation. If the student does not accept the relation, then the instructor will seek to describe a “bridging analogy” to moderate between the target and anchor.</p> <p>Brown &amp; Clement (1989) found that best results for bridging analogies must include a usable anchor for students and that the anchor should build off of students’ beliefs in an interactive teaching environment, rather than through a lecture or textbook.</p> <p>To learn more about analogies used in science education, click the link provided in the slide.</p> <p><b>See file</b></p>
8	Interactive Lecture Demonstration	<p>An additional strategy to helping students conceptualize through overcoming misconceptions is to present interactive lecture demonstrations. This demonstration begins with an introduction to a situation that the instructor can perform in class. The teachers first asks students to discuss the situation with their partner and then predict what is going to happen. And after the demonstration is over, students can reflect on the outcome. Different types of demonstrations an instructor could use include classroom experiments, classroom surveys, data analysis, and simulations that begin with “What If?”</p> <p>In order to effectively use interactive lecture demonstrations, instructors should identify the core concept that students should learn, choose a demonstration that will illustrate that concept – preferably with an outcome that is different than what students are expecting, and prepare written materials so that the steps for students to predict, experience, and reflect are structured (Carleton College, 2018).</p>
9	Interactive Lecture Demonstration	<p>Pause the module and take a moment to brainstorm and write down two ways in which you could use bridging in your classroom and two ways that you could use an interactive lecture demonstration based off of lessons you have planned and taught in the past.</p>
10	Generalize	<p>In addition to being able to conceptualize information, “learners need to be able to generalize and transfer their learning to new contexts” (UDL, 2018). Generalization is a proponent of transfer of learning, as reinforced knowledge or skills of a specific situation could be applied in a new situation.</p> <p>Generalization in the classroom is significant because it asks learners to create a solution that might not pertain to a single problem, rather a collection of related problems (NRC, 2000). One example of a common generalization in science is experimentation, as concepts of math and science are easily transferred to an applicable context.</p>

11	Generalize	<p>The National Research Council (2000) identifies a handful of dimensions of transfer, including vertical transfer, in which teaching basic skills (such as writing letters of the alphabet) are useful is specialized skills (such as writing words). “Near transfer” is the ability of a student to transfer from one school task to a highly similar school task, and “far transfer” could be the transfer from one school task to a real-world, non-school task.</p> <p>It is important to note that while providing students with several contexts in which they can generalize and transfer their learning, over-contextualizing information can actually reduce a student’s ability to be able to transfer what they know to another context (NRC, 2000).</p>
12	Generalize	<p>Students may require different amounts of scaffolding in order to improve their ability to access prior learning through memory and transfer. All learners can benefit greatly from assistance in practicing transfer among multiple contexts. Without this support, learners might know the information needed, but will not be able to access it in new situation. Supports for generalization and transfer include techniques that make information more memorable and meaningful. Teachers can provide this type of support by:</p> <ul style="list-style-type: none"> <li>• Providing checklists, graphic organizers, or sticky notes</li> <li>• Encouraging the use of mnemonic devices such as visual imagery and paraphrasing strategies</li> <li>• Incorporating opportunities to review and practice new information</li> <li>• Providing scaffolds to link new and prior knowledge such as word webs and concept maps</li> <li>• Embedding new ideas in familiar contexts through analogies, metaphors, music, and film</li> <li>• And providing opportunities for students to generalize learning to new situations, such as how we discussed in the previous slide.</li> </ul>
13	Review	<p>As we come to a close, let’s consider all we have covered so far. We started this module by discussing strategies to strengthen students’ abilities to conceptualize through bridging and interactive lecture demonstrations. We then finished the module by discussing strategies to help students be able to generalize and transfer knowledge and skills into various contexts.</p>
14	Sources	<p>Brown, D. &amp; Clement, J. (1989). Overcoming misconceptions via analogical reasoning: Factors influencing understanding in a teaching experiment. **Presented at American Educational Research Association, San Francisco, CA: March 1989**</p> <p>Carleton College Science Education Resource Center. (2018). Types of Demonstrations. Retrieved from <a href="https://serc.carleton.edu/introgeo/demonstrations/demotypes.html">https://serc.carleton.edu/introgeo/demonstrations/demotypes.html</a></p> <p>Ylvisaker, M. (2006). Transfer of training. The Brain Injury Association of New York State. Retrieved from <a href="http://www.projectlearn.net.org/tutorials/transfer_of_training_or_generalization.html">http://www.projectlearn.net.org/tutorials/transfer_of_training_or_generalization.html</a></p>

		UDL Guidelines. (2018). Maximize transfer and generalization. Retrieved from <a href="http://udlguidelines.cast.org/representation/comprehension/transfer-generalization">http://udlguidelines.cast.org/representation/comprehension/transfer-generalization</a>
15	Credits	Thank you for viewing this module.