Backward Design

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Mrs. Kinney loves science—she just wishes that her students were as enthusiastic about the subject as she is. She covers all the information in the textbook with lectures and PowerPoint notes, and even includes an experiment at the end of most units. Even with all of this, her students at best memorize information for a test; they never retain it beyond the test. In the last unit she covered, her students kept complaining, "Why do we have to know this?" "This is not going to help me in life." How can she get her students excited about learning? How can she help them to truly understand the content and how it relates to their lives?

As teachers respond to the mandates of the No Child Left Behind Act of 2001 and contemplate the import of research documenting poor learning outcomes for students with disabilities, the key challenge is to design curriculum and instruction that facilitate understanding, retention, and generalization (Bulgren, Deshler, & Lenz, 2007). To meet this challenge and adequately prepare students to meet curricular standards, teachers must reach beyond past practices of teaching for curriculum exposure and utilizing books as curricular guides (Carnine, 1991; Gersten, Baker, Smith-Johnson, Dimino, & Peterson, 2006). This requires a paradigm shift in which textbooks are one of a variety of teaching tools rather than the sole basis for daily teaching.

The move away from textbook-driven curriculum, though, is not a novel approach. It is rooted in the constructivist approach currently finding favor in education through the work of educational theorists applying the approach in curriculum design models (Wiggins & McTighe, 2006). Past and current applications of *constructivism* focus on how students construct understanding. Students' prior knowledge and experiences are organized into schema, patterns, and connections for understanding and remembering. Key to all applications of constructivism is that children need opportunities to connect their prior knowledge and experiences with new information through their own thought processes and through interactions with others and the environment (Scruggs & Mastropieri, 1994). Such opportunities allow students to use their schema as a basis on which to build a framework for understanding new ideas and information. Through this gradual building or *scaffolding* of knowledge and skills, students can be supported to move beyond rote knowledge and develop depth of understanding.

Curriculum design is at the center of developing student ability to construct understanding. Without appropriately designed curriculum, instruction can be ineffective at scaffolding

TEACHING Exceptional Children, Vol. 41, No. 5, pp. 6-14.

Targeting Depth of Understanding for All Learners

understanding. Often students with disabilities need more explicit instruction or guidance in applying their schema to new information (Mastropieri, Scruggs, & Butcher, 1997). Thus, instruction must not only be carefully scaffolded; it must also address students' unique learning needs (see "What Does the Literature Say About Engaging Students and Responding to Special Learning Needs?").

Why do so many students fail to develop understanding of key concepts within content? The answer is that instruction is too often driven by textbooks, lectures, worksheets, and activities that fail to make learning relevant for students (Scruggs, Mastropieri, & McDuffie, 2007) and are not grounded in curricular standards. Designing curriculum and instruction that scaffolds learning is a vast paradigm shift for many teachers and may require retraining of teaching methods. One design approach that has been highly useful for retraining teachers to design curriculum for scaffolding learning is the *backward design* approach (Wiggins & McTighe, 2006), easily utilized with general education curriculum. This approach can be implemented in inclusive classrooms with students with disabilities and across content areas and grade levels.

The Backward Design Approach

Teacher understanding of the difference between student knowledge and student understanding is critical to implementing a backward design approach. Just because a student can memorize facts for a test does not mean he understands what they mean. For example, a student may know that the tilt of the earth's axis causes the earth's seasons because he memorized the fact. However, he may have no idea how the tilt actually causes the seasons; if asked to explain his answer, he would be unable to articulate an explanation.

Children need opportunities to connect their prior knowledge and experiences with new information through their own thought processes and through interactions with others and the environment.

Developing instruction that targets such level of understanding requires thoughtful planning and the backward design steps can serve as a guide. Authors Wiggins and McTighe (2006) argue that you cannot plan how you're going to teach until you know exactly what you want your students to learn: backward design planning focuses on learning outcomes, and standards and the assessments for accomplishing

What Does the Literature Say About Engaging Students and Responding to Special Learning Needs?

Scruggs, Mastropieri, Bakken, & Brigham (1993) found that students engaged in an inquiry-oriented and experiential science curriculum performed better on end-of-unit tests and follow-up tests as compared to students whose curriculum utilized a textbook approach. Further research has indicated fewer discipline problems (e.g., suspensions, behavioral conferences, vandalism) when students are engaged in a hands-on, experiential curriculum (Cawley, Hayden, Cade, & Baker-Kroczynski, 2002). Development of social and personal responsibility often accompanies decrease in negative behaviors.

Despite these benefits, students with disabilities may still need individualized support and accommodations to benefit from classrooms employing experiential or other active learning methods (Deshler, Schumaker, Lenz, et al., 2001). Research indicates that students with disabilities—especially students with mild intellectual disabilities—need to receive increased training in research-based learning strategies and increased guidance to direct their knowledge construction (Deshler, Schumaker, Lenz, et al.; Scruggs & Mastropieri, 1994). The level of support needed must be determined by ongoing formative assessment of student understanding and knowledge construction (Scruggs & Mastropieri). Such learning needs do not necessitate a restrictive learning environment; general education classrooms utilizing active learning, ongoing assessment, and appropriate support strategies are supportive learning environments that can optimize student learning and potential for students with disabilities (Schumaker et al., 2002).

those standards. These assessments then guide the development of the learning activities (i.e., instruction and activities). With the learning outcomes clearly articulated as assessments, creating learning activities that scaffold understanding toward those outcomes is a more straightforward process. Applying this approach in classrooms with students with disabilities involves four key steps.

Step 1: Identify Learners

Knowing your learners is foundational to designing curriculum (Bulgren et al., 2007). Prior knowledge, experiences, and interests students bring to the classroom—as well as special learning or behavioral needs—influence student learning. Thus, learner needs should be considered throughout all steps of the design process.

Identify Classroom Needs. First, identify the class targeted with the curricular unit. Beyond general information such as grade and subject, it is important to consider the contextual variables that impact your students and shape their experiences outside of school. Consider such factors as community location, resources, socioeconomic level, extracurricular activities, and educational background, all of which have an immense impact on students and the prior knowledge and schemas they bring to the classroom.

Identify Individual Student Needs. Second, you must identify learners who have special needs and determine their individual learning needs. A teacher should be intimately aware of each individual student's strengths and weaknesses, how a student's disability impacts learning, and what techniques or accommodations are necessary to support the student's learning. Identification of these needs and supports must be in place before a teacher can design appropriate assessment and learning activities, because student needs must shape instructional design. Accommodations must be woven throughout the fabric of instruction; never should they be an afterthought, an add-on to a lesson. For students with disabilities, accommodations are an integral component to scaffolding understanding (Bulgren et al., 2007).

Step 2: Identify Curricular Priorities

Determine State and Local Standards. State and local standards will focus the unit. Some teachers have more freedom in this decision, whereas others have strict parameters. For instance, some school systems publish pacing guides to outline curricular requirements; in some schools, teachers work in teams to determine content to target; in yet other schools, individual teachers determine how and when they will address specific standards. Regardless of how curricular priorities are chosen, the steps of the process work the same: The standards serve as the learning goals that will shape the instructional unit.

For students with disabilities, accommodations are an integral component to scaffolding understanding.

If you are determining your own standards, choose a key standard to drive the unit that targets deeper and broader understanding, a standard that encompasses or readily bridges to other standards. For instance, with social studies standards related to Africa, a standard on African civil war is a broad issue that could incorporate other standards (e.g., natural resources, geographic locations, the independence movement, political development). To further enhance your unit, consider timing. Design units around standards that address current news topics (e.g., teaching about the role of the judicial branch in government as the Supreme Court reviews a hotly debated issue) or target standards during times of the year when key teaching resources are available (e.g., a unit on ecosystems taught during spring would offer much more opportunity for experiential learning than if taught in inclement winter weather).

Create Essential Questions. Essential questions frame the standards of the unit in a way that hooks or engages learners, and serve to bridge the standards and the curriculum by guiding students in creating meaning around the standards (Bulgren et al., 2007). Well-written essential questions pique student curiosity and draw them into the subject, encouraging learning beyond rote memorization. Ideally an essential question is not answered after a single lesson, but is continually revisited throughout a unit. What should be most clear to students from the essential question is that their job is inquiry, not just a simple answer (Wiggins & McTighe, 2006). Revisiting the essential questions throughout a unit keeps students focused on the "big ideas" so that they continually consider how the various learning tasks and content contribute to their understanding of the major goals or standards of the unit.

Identify Prerequisite Knowledge and Skills. Because scaffolding student learning is critical to the development of schema and student understanding (Carnine, 1991), examine your standards and consider if there are prerequisite knowledge and skills students need to successfully accomplish the identified learning standards. Failing to consider necessary prerequisite knowledge and skills is a frequent mistake of beginning teachers, but it also occurs with experienced teachers. For beginning teachers the mistake may involve failing to recognize prerequisite *content* knowledge or skills needed to accomplish a standard (such as a teacher creating a unit on budgeting without first ensuring students have prerequisite math knowledge and skills). For experienced teachers, the gap is more often in recognizing the *enabling* skills that students need to convey content in the manner requested. Students might perform poorly when expected to engage in debate, research, or group work, not because they fail to understand the content but because they do not have the skills for conveying knowledge in the manner requested.

If the class does not possess prerequisite skills, consider how to proceed. Are the prerequisites minimal

such that they could be adequately addressed within the unit? Would the unit be more constructive later in the year after other prerequisite standards have been taught? Also, consider individual students. Are there individuals who do not possess prerequisite knowledge and skills (e.g., spelling skills for a writing unit) due to disability? If so, consider accommodations be made so they can successfully participate. As you move forward, you will find it useful to revisit this step to ensure students have prerequisite knowledge and skills for successful completion of all components of the unit.

Step 3: Design Assessment Framework

In this step, you develop the assessments used to determine if students have mastered the standards. The key question is "What evidence will demonstrate student understanding of the unit standards?" Evidence is never a single assessment product (Swanson & Deshler, 2003). Ongoing and frequent assessment is fundamental to scaffolding student understanding. Also key is a framework of assessments that gradually build student ability to use knowledge and skills at increasingly sophisticated levels. The aim is to move students beyond the recall of memorized facts to deeper understanding of the meaning of content in applied contexts and in relation to other concepts. The understanding targeted within each unit varies depending on the standards, but students can reach deeper understanding through assessments that require explanation, interpretation, application, analysis, synthesis, and self-evaluation. To target this depth of understanding, build an assessment framework including the following types of assessments (Wiggins & McTighe, 2006).

Performance Tasks or Projects. Create one or two tasks or projects that require students to demonstrate depth of understanding of major or overall unit concepts. This assessment will serve as the anchor to your unit. A performance task or project should challenge students to use the content in a flexible way to answer or solve problems that mirror real life. A detailed rubric should be developed to clarify expectations, guide student performance, and encourage student self-assessment.

Oral or Written Prompts. These are open-ended questions that move beyond memorized facts by requiring students to explain, analyze, and/or evaluate. Prompts are similar to essay questions, but always require critical thinking to develop and justify a response. Prompts are most effective when used as a more formal assessment (i.e., typical test conditions).

Quiz or Test. Although teachers usually use tests at the end of a unit as a summative assessment, tests are best used as a formative assessment to gauge if students have gained the knowledge and skills needed for activities and assessments that target deeper understandings. Include tests or quizzes for vocabulary, knowledge, and skills students need to accomplish prompts and performance tasks or project assessments.

Informal Assessments. Informal assessments are the means for preparing students for all other assessments. Use a variety of informal assessments such as observations, class activities, discussions, and teacher questions throughout the unit to reveal student understanding or misunderstanding, and determine any need for additional instruction (Gersten et al., 2006).

Step 4: Create Learning Activities

This final step integrates information from all prior steps into a sequence of lessons that guides students toward accomplishing the desired understanding and assessments. In developing learning activities, consider the specific needs of students with disabilities so that any required accommodations are an integral part of the unit. Often it is supportive of classwide learning to provide accommodations to the group rather than to an individual (e.g., interactive group work, graphic organizer; Gersten et al., 2006). As you move through building a sequence of lessons, continually refer to student learning needs (Step 1), standards (Step 2), and assessments (Step 3) to maintain your focus.

Design and Sequence Learning Activities. Keep in mind these key considerations as you plan your learning activities: How will you encourage immersion in and exploration of the essential questions? How will you use learning activities to build knowledge and skills, and promote deeper understanding? How will you prepare students for accomplishing the project and prompt assessments? To translate these questions into practice, consider utilizing the following components to facilitate the scaffolding process:

- Engage students with essential questions and unit vocabulary
- Break instruction and activities into manageable parts
- Weave assessment across the unit

Begin the unit by engaging students with the essential questions and key unit vocabulary. Engaging students with the standards and essential questions using techniques such as visuals, problems to solve, and controversial issues not only generates interest and excitement, but makes the learning meaningful (Wiggins & McTighe, 2006). Students need to know where they are going and what they are expected to accomplish (Swanson & Deshler, 2003). Provide instruction of key vocabulary prior to reading and learning activities so that when students encounter vocabulary within the learning activities they have a base understanding on which to build. This is particularly beneficial for students with disabilities (Vaughn & Bos, 2009). Beginning with the essential questions and vocabulary provides opportunities to connect with student prior knowledge and experiences to build new schema and to address misconceptions so that students are not building knowledge on faulty bases.

Break instructional parts of the unit into manageable elements; divide class time into mini-instruction, activity, and reflection/discussion sessions to actively immerse students in the content. Breaking up instruction in this way not only provides students an opportunity

to develop schema by utilizing the new content, but also eliminates the risk of frontloading a unit with instruction that diminishes student engagement. In designing learning activities, avoid teacher-directed and textbook-driven instruction where students merely recite notes or readings (Scruggs, Mastropieri, Bakken, & Brigham, 1993). Instead, give students opportunities to make the content meaningful by connecting it to real life. Personalize the learning by creating opportunities to see how the information relates to what they know and to their lives—their past, present, or future (Deshler, Schumaker, Bulgren, et al., 2001). Learning activities should encourage students to apply information, make interpretive judgments, and/or synthesize information to generate knowledge and gain understanding of the larger issue (Bulgren et al., 2007; Scruggs & Mastropieri, 1994). Start small and build toward the higher levels of understanding expected in the assessment prompt and performance task or project. The learning should be driven by student efforts to answer essential questions and solve problems posed through unit activities and assessments. Through reflection and discussion continually revisit essential questions and central concepts so that students understand how new information applies to the larger understanding targeted (Gersten et al, 2006). This overall approach to learning activities moves students out of passive roles into active learning roles more supportive of learning for students with disabilities, because learning is hands-on and meaningful.

Weave in assessments across the unit to enable continuous insight into the development of student understanding (Wiggins & McTighe, 2006). Assessments should gradually build toward depth of understanding; tests and quizzes should be applied early on as formative assessment of student understanding of base concepts, but project and performance assessments are most effective as summative, culminating assessments as they allow students to demonstrate an integrated understanding of unit concepts. Further, it should be completely transparent to students how the content relates to the assessments and what is expected from each assessment. This is accomplished by designing learning activities that provide the students with experience in making the types of transfer sought and by providing explicit assessment instruction through such means as detailed rubrics and clearly defined steps. When students fail to perform on assessments, it is often because teachers failed to prepare them to make the transfer of knowledge. Use learning activities to develop the understanding sought for assessment.

Give students opportunities to make the content meaningful by connecting it to real life.

Check for Integration of Accommodations. Review learning activities to ensure all learners' needs identified in Step 1 are supported. Certain needs, accommodations, or individualized education program (IEP) goals (e.g., graphic organizers, group interaction, organization skills) work well and, when implemented classwide, can enhance performance for all students (Gersten et al., 2006; McTighe & Lyman, 1988). For instance, if oral expression is targeted on one student's IEP, might not the entire class benefit from working on this skill? You could work oral expression into one of your assessments and then enhance a learning activity to provide the instruction, modeling, and guidance students need to develop the skill. Other student needs may require individual support (e.g., a student may need to talk through project instructions individually with a teacher or may need assistive technology for reading and writing activities).

The process is not completely linear. Once you have the general framework of the information generated from the steps, you may find that it is necessary to move back and forth within the steps as you further conceptualize your instructional unit. As you move into implementation, ongoing analysis of learning results and reflection on implementation will provide feedback for refining your use of the approach.

Applying Backward Design in the Classroom

Figure 1 outlines the use of the process with an inclusive second-grade classroom and Figure 2 outlines use with an inclusive high school biology class. Key applications of the process illustrate how to design instruction to support higher levels of understanding for all students.

Elementary-Level Example

Most of the students in this inclusive second grade class had not traveled outside their rural county, so they did not have travel experiences upon which to build schema for the new content (Step 1). In addition, a large number of the students had disabilities and needed interactive learning experiences with repetition and feedback. The general and special education teachers chose to address standards from two separate disciplines (i.e., social studies and language arts); the social studies unit would serve as an engaging framework for instruction in writing (Step 2). The teachers used essential questions to focus students on critical state content requirements and to link those requirements to the motivating topic of vacation plans. The brochure project linked the required writing and social studies understandings as well as anchored the assessments and subsequent learning activities (Step 3). Additional assessments helped build knowledge and skills for the completion of the brochure. Assessments guided students to use content to identify, then to compare

Figure 1. Elementary Level Unit: Second Grade Social Studies and Language Arts

Step 1: Identify Learners	Identify classroom needs	• Second-grade inclusive classroom • One third of students have disabilities • Low- to mid-income families • Limited travel and experiences outside of local rural area
	Identify individual student needs	• Mario, Vicky, Darius, Kayla: simplified instructions, visuals and graphic organizers to break down content and to increase recall, small group, repetition • Adam, Terrika: redirection, encouragement/positive feedback, small group, hands-on learning • Trey: extensive feedback and encouragement
Step 2: Identify Curricular Priorities	Determine state/local standards	• Social Studies: The student will locate major topographical features of the state and will describe how these features define the state's surface. • Language Arts: The student will write a paragraph that states and supports an opinion; use planning ideas to produce a rough draft; give and receive feedback; and make revisions based on feedback.
	Create essential questions	• What cities, landmarks, and attractions are in different regions? Why? • How would information about the regions guide your vacation plans? • Which region would you most/least like to visit and why?
	Identify prerequisite knowledge and skills	• Basic map reading skills • Write sentences to form simple paragraph
Step 3: Design Assessment Framework	Performance tasks or projects	• Create a brochure to persuade others to visit a chosen region of the state; use rubric to clarify requirements for brochure.
	Oral or written prompt	• Written reflection in booklet about each region: What makes this region unique?
	Quiz or test	• Vocabulary quiz (e.g., climate, topography, region, mountain, river) • Regions and rivers quiz
	Informal assessments	• Small group or class activities (e.g., Jeopardy activity, Velcro-create-a-map; Web site quiz games) addressing region information cumulatively • Small group map creation
Step 4: Create Learning Activities	Design and sequence learning activities	• Present essential questions, vocabulary, map, and intriguing landmark photos • Vocabulary quiz • Present region information – Encourage student sharing of prior knowledge, vocabulary use, and student contrasting/comparing regions – Prompt student completion of graphic organizer during lesson – Written reflection for booklet – Include informal assessment activity (small group or whole class) • Small group clay map creation activity • Regions and rivers quiz • Trip to visit landmarks in our region • Introduce brochure project; model use of think sheet to guide writing process for brochure • Model use of peer editing checklist; guide peer assessment of writing and revision of writing • Complete writing and artwork for brochures; share brochures
	Check for integration of accommodations	• Visuals (e.g., slides to show unique aspects of each region) • Mini-lessons and activities to increase engagement • Learning supports (e.g., graphic organizer for regions, think sheet for writing) • Center and small-group activities for individual support

and contrast, and finally to persuade readers about state regions and topographical features.

For Step 4, learning activities for developing understanding of the social studies content included interactive instruction, a reflective writing prompt, and an activity to apply information. Interactive instruction used discussion and informational slide shows replete with photos, along with teacher modeling and student completion of graphic organizers. Activities ranged from small-group activities where students tracked and e-mailed a hiker as he traversed regions of the state to class activities in which students created clay map models while the teacher guided them with questions targeting basic knowledge (e.g., "What river empties into the Atlantic Ocean?" "What region is north of the region in which we live?") and higher-order thinking (e.g., "Why are so many man-made attractions centered in that region?" "How does the climate and geography of the Coastal Plains region differ from the Blue Ridge region?"). Most of the needed accommodations for this unit were implemented classwide as they constituted best practices for all students. Use of photos, Web site tours, and a field trip created visuals and experiences upon which students could develop their schema. Use of a graphic organizer for each region and a think sheet to guide the writing process supported the learning for all. Finally, there were opportunities for small-group learning with peer interaction for both social studies activities and writing feedback.

With this approach, performance increased for all students, with and without disabilities. The author implementing this instruction attributed the increase to (a) the use of essential questions which gave students the big picture and encouraged more in-depth thought; and (b) scaffolding and active learning that created a student-centered environment and encouraged students to develop understanding step by step. Due to the interactive nature of the learning activities, the teacher needed to redirect students and focus attention more often, but the learning outcomes far outweighed the increased classroom management needs. Students normally reticent to participate eagerly engaged, and, weeks after the instruction, students continued to discuss the activities.

High School Example

This class comprised a range of science-related experience and learning level. Although most students had limited interest, several were involved in Science Club and brought unique insight into the classroom (Step 1). With appropriate prompting, the Science Club students shared this interest with their classmates and served as a support for struggling students (needs ranging from learning disabilities to mild intellectual disabilities to attention deficit hyperactivity disorder). The curriculum sequence for this unit was determined by the school and was designed to build on prior understanding of DNA (Step 2). The challenging task in designing the unit was making the content real and connecting it to student lives so as to reduce abstraction and enhance understanding. Multiple essential questions guided students to see overall connections between genetics and their lives, and guided scaffolding by breaking down complex ideas. In Step 3, assessments continued to build these connections by making concepts applicable to student interests and "real life" (e.g., cartoon characters, pets, classmates, current news issues).

In Step 4, learning activities that involved instruction were divided into introductory lecture, application activity, and discussion. Stopping activities midway to prompt students to verbalize connections between content and the activity facilitated scaffolding. Students put their ideas into their own words, which served multiple purposes: it helped solidify student understandings, gave insight into struggles with concepts, and allowed the teacher to use student understanding as a stepping stone for extending ideas. Students supported and guided one another when working in small groups or pairs. Teachers continually modeled for students how to teach one another through questioning rather than just by

Figure 2. High School Level Unit: Biology

Step 1: Identify Learners	Identify classroom needs	• Inclusive biology classroom • 20 students, including 5 with disabilities • Several students in science club
	Identify individual student needs	• Ryan: provide visuals, verbal directions/explanations, processing time • Venicia: pair with peer for written class tasks, oral responses to quizzes and writing prompts • Latrell: pair with organized, even-tempered peers • Marcus: prompts to focus, hands-on activities • Tina: extra time, additional support with abstract ideas
Step 2: Identify Curricular Priorities	Determine state/local standards	• Students will analyze how biological traits are passed on to successive generations. – Using Mendel's laws, explain the role of meiosis in reproductive variability. – Explain how mutations occur and why genetic disorders result. – Examine use of DNA technology in medicine and agriculture. • Students will demonstrate content area vocabulary knowledge through writing and speaking.
	Create essential questions	• What does probability have to do with genetics? • How are traits, including some you do not see, passed from one generation to the next? • How do meiosis and mitosis impact genetic information and cell production? • What happens to traits when meiosis fails? • Who has the right to access and make decisions about your genetic code?
	Identify prerequisite knowledge and skills	• Prior understanding: DNA
Step 3: Design Assessment Framework	Performance tasks or projects	• Predicting and designing offspring project: Given cases with mono and dihyrid crosses, and incomplete dominance and co-dominance, students will predict genotypic and phenotypic combinations of offspring. • Genetics defense project: Research and defend a controversial topic related to use of genetics in medicine or agriculture.
	Oral or written prompt	• Use Mendel's laws to explain the presence or absence of a link between a dog's hair color and tail length. • What different occurrences in mitosis and meiosis explain why human families look different from one another, whereas bacteria show no variation from parent to offspring?
	Quiz or test	• Vocabulary quiz • Vocabulary/content quiz
	Informal assessment	• Informal discussion • Create-a-face coin toss activity • Classroom trait survey • Mutations activity • Genetic mutations activity
Step 4: Create Learning Activities	Design and sequence learning activities	• Present essential questions, Mendel and his experiments; check for misconceptions about genetics • Introduce probability and Punnett squares Activity: determine facial phenotypes using coin-toss. • Vocabulary quiz. • Prompt: applications of Mendel's law. Introduce incomplete dominance and co-dominance. Activity: create and explain cartoon parents' offspring • Predicting and designing offspring. Performance task: Punnett squares • Introduce meiosis. Activity: survey of classroom traits. • Introduce mitosis. Class discussion: compare/contrast mitosis and meiosis; utilize graphic organizer. • Vocabulary/content quiz. • Prompt: mitosis and meiosis. Introduce genetic mutations using videos that demonstrate traits of disorders caused by mutations to genetic code. Activity: use interactive whiteboard to create and explain different types of mutations. • Introduce genetic ethical issues with segment of movie Gattaca (Niccol, 1997) and discussion. Genetics defense project: choice of topic; rubric to clarify required components; pair sharing and graphic organizer to support reading and formulation of arguments. • Students present and defend research-informed position. Self- and peer assessment to identify strengths and weaknesses of argument and presentation.
	Check for integration of accommodations	• Break up lessons into instruction, activities, and discussion • Use small-group time to provide additional explanations • Instruct students how to teach one another in small group activities • Use classwide learning supports (e.g., graphic organizers, rubric) • Address individual needs (e.g., prompt sheet for Punnett squares, screen-reading software)

giving answers. Various supports ensured that all student learning needs were met; for example, a student who struggled with abstract and complex concepts used a prompt sheet for creating Punnett squares and was then able to progress to understanding how Punnett squares applied to genetic traits. In other instances, supports applied classwide enhanced learning for all students. The research project on ethical issues surrounding genetic research incorporated both individual and classwide supports:

- Screen-reading software helped students with disabilities access the articles.
- All students were paired with peers by topic to paraphrase articles and discuss how the information related to their stance.
- The teacher provided and modeled use of a graphic organizer to guide translation of article information into a persuasive argument.

This combination of supports enhanced learning for all students.

With use of this approach, students with disabilities maintained active engagement in learning activities and achieved the general curriculum objectives. The essential questions and differentiation of learning activities were key to learning success. The essential questions made the science concepts more concrete and created a focus for learning activities, especially helpful for students with disabilities. Prior to any discussion, students understood how the activity related to the question they were trying to answer; the questions served as a reference point upon which students created a framework to organize and understand the concepts. In addition, the small-group application activities and project enabled differentiation of instruction and addressed diverse learning styles. Grouping students based on individual needs and teaching questioning techniques within these activities allowed students with disabilities to actively participate in applying and explaining concepts. The backward design approach facilitated the equal participation of students with disabilities in all aspects of the classroom learning community.

Final Thoughts

Increasing numbers of students with disabilities are being educated in inclusive general education classrooms; the challenge is to provide appropriate instruction to support student success. Traditional instructional approaches too often fail to engage learners with disabilities, to address their individual needs, and to ultimately support academic success. Designing curriculum that both accommodates learning needs and targets deeper levels of understanding is possible. Through the use of the backward design approach, learning can become relevant and meaningful for all students, supporting their mastery of general curricular standards. When standards, assessment, and inquiry-oriented activities drive the curriculum, learning can be transformed.

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TEACHING Exceptional Children, *Vol. 41, No. 5, pp. 6–14.*