Differentiation and the Learning Brain

Welcome to Ms. Rickard's eighth-grade classroom. The thirty students range from accelerated gifted, to those on grade level, to those with special learning needs, and to those who are English language learners. She has the choice: teach to the middle and hope not to bore the advanced learner or frustrate those struggling with information processing or attention, or vary instruction in ways to meet the range of adolescent learners. She chooses the latter. Not wanting to compromise essential content for anyone, she works with the media specialist to find materials with varied reading levels. Knowing her students differ in how they receive and process information, she uses varied and multiple ways to present subject matter, including auditory, visual, and kinesthetic. Not wanting to make any of her students feel categorized as "slow" or "disabled," she designs tasks that vary in complexity but not in challenge, meaningfulness, or relevance. Wanting to create and maintain sense of community, she groups the adolescents in multiple ways, depending on abilities and personal preferences. Wanting to tap into her students' talents and interests, she gives them choices in how to show their learning. Wanting to motivate, she takes time to assess each student's learning style and preferences, interests, and readiness levels. In Ms. Rickard's classroom, one size does not fit all. Differentiation is apparent.

Differentiation in the adolescent classroom is a commonsense approach that takes into account the learning and development needs inherent in a range of academically diverse students. Adolescent learners differ in cognitive ability, social and economic status, literacy and language proficiency, race, ethnicity and culture, background, prior knowledge, quality of family support and

degree of opportunity, motivation, learning preferences, and interests. Who adolescents are, the complex composite of biology and experience, determines the learning strengths and academic challenges they bring to the classroom. Neuroscience further reveals distinct variations in the way adolescents' brains receive, strategically process, and emotionally relate to content, instructional delivery, and assessment (Rose & Meyer, 2002).

IT'S ALL ABOUT GOOD TEACHING PRACTICE

Many of the instructional practices suggested for differentiation are familiar ones. Best-practice teaching (Brandt, 1998) has shown that students learn best when what they learn is personally meaningful, challenging, and appropriate to their developmental level. They learn best when they have choices and learn in their preferred way, when they have opportunities to interact socially, use what they know to construct new knowledge, acquire strategies for learning, and receive helpful feedback. They also learn best in an emotionally positive and supportive environment where they are valued and respected as worthy individuals.

As a matter of necessity, the majority of teachers already make adjustments in curriculum and instruction to allow for student differences in the classroom. They may give students choices of books to read, vary journal prompts, incorporate discussion groups based on interest or ability, ask multiple levels of questions, or arrange for reading buddies. These are examples of good teaching practices that value student choice, student talk, and student differences. Other practices that take more preparation time include tiered activities and products, literature circles, interest centers, learning contracts, compacting, simulations, group investigation, and problem-based learning, to name a few (Tomlinson, 2001).

Tomlinson suggests that teachers begin to differentiate with the more time-consuming strategies at a comfortable pace. She encourages teachers to start small and build on what is familiar. A teacher might collaborate with the media specialist to find varied reading sources or multilevel supplementary materials for a social studies unit already developed or previously taught. Another might incorporate small literature circles based on interest or ability. A math teacher might tier a word problem based on complexity; a science teacher might tier a task. Still another might give students choice on the format for culminating products. Teachers who teach multiple subjects are advised to begin with the one they enjoy the most. By working in a cumulative manner from semester to semester and year to year, differentiation is more manageable.

> **Adolescent-Centered Differentiation**
>
> A strategic approach to curriculum design and instruction that builds meaningfully and responsively on adolescents' unique developmental needs and learning strengths.

Chapter 1 explores innovative research associated with the adolescent learning brain, describes the differentiation philosophy of UDL, and introduces key terminology related to classroom differentiation. It defines differentiation as a strategic approach to curriculum design and instruction that builds meaningfully and responsively on adolescents' unique developmental needs and learning strengths. The chapter identifies and

illustrates six key design principles that characterize adolescent-centered differentiation.

THE LEARNING BRAIN

Although human brains share the general characteristics of intake and sense making, individual brains "differ substantially" in the way they recognize, internally process, and assign emotional significance to new information, teaching strategies, and materials within the learning environment (Rose & Meyer 2002, p. 13). Brain imaging of neural activity during learning discloses an astonishing multifaceted communication network that is comprised of three smaller networks, each functioning distinctively and collectively as students learn. These smaller brain systems are (1) the recognition network, which enables students to identify clues and patterns and to associate meaning with information, ideas, and concepts as they attempt to understand (the "what" of learning); (2) the strategic network, which specializes in executive functioning and allows students to plan, carry out, and monitor actions and movement (the "how" of learning); and (3) the affective network, which evaluates and assigns emotional value to incoming information and impacts students' level of engagement (the "why" of learning). These networks parallel Vygotsky's (1962) three prerequisites for learning: information recognition, strategic processing, and learning engagement.

> **The Learning Brain**
>
> The multifaceted communication network comprised of the smaller networks—recognition, strategic, and affective—which function distinctively and collectively as adolescents learn.

Specialized tissues within each of the three neural networks perform certain tasks (Rose & Meyer, 2002). Different tissues in the recognition network, for example, respond to visual stimuli, and other tissues recognize auditory patterns. Different parts of the strategic network control goal setting, and other parts direct people to execute these. Similarly, specialized areas in the affective network may associate positive or negative emotions with subject matter, instructional strategy, teacher style and presentation, learning conditions, and assessment method. During the learning process, students' brains make rapid and simultaneous associations as incoming information is distributed and processed. The recognition network takes in information through multiple sensory avenues (visual, auditory, olfactory, tactile). The strategic network identifies a learning goal, selects and executes a strategy, and evaluates the outcome. Negative or positive emotional responses in the affective network influence students' motivation and ability to engage and progress.

These pertinent findings in neuroscience reveal that adolescents' learning brains specialize in complex and varied ways. "Learners cannot be reduced to simple categories such as 'disabled' or 'bright.' They differ within and across all three brain networks, showing shades of strength and weakness that make each of them unique" (Rose & Meyer, 2002, p. 11). To maximize the chance for more students to succeed academically, teachers are challenged to rethink how they present new information, the opportunities they give students to process and express learning, and the ways they engage and motivate. They need to have multiple and varied methods of presentation, offer more flexible ways

for students to make sense of and represent learning, and seek to accommodate their varying interests and learning preferences. Building on individual learning strengths through multiple means of representation, expression, and engagement is the underlying premise of UDL.

UNIVERSAL DESIGN FOR LEARNING (UDL)

UDL is a differentiation approach to curriculum design and instruction that responds to the learning brain (Rose & Meyer, 2002). UDL interjects variety and flexibility into the way information is represented (in support of the recognition network); the skills and strategies students employ to learn and demonstrate competence (in support of the strategic network); and the emotional engagement and enjoyment in the process (in support of the affective network). When teachers provide multiple and flexible representations of a concept and multiple ways for students to participate and engage, they accommodate students with learning challenges *and* create a more flexible and cognitively stimulating learning context for other students in the class.

> **Universal Design for Learning (UDL)**
>
> A differentiation approach to curriculum design and instruction that responds to the learning brain. It encompasses flexibility in information representation, strategic learning and demonstration of competence, and emotional engagement.

UDL in Practice

Ms. Dixon, an eighth-grade math teacher, plans to teach students the numerical phenomenon of the Fibonacci number. Some of the students will process the concept readily if she shows pictures of nautilus sea shells or arrangements of seeds on flowering plants. For a student who is visually impaired or has difficulty discerning spatial relationships, however, the use of visuals as a representation strategy would be limiting. Acknowledging the ranges of learning strengths and challenges among students in the class, Ms. Dixon offers multiple and flexible ways for them to learn the concept. She accompanies visuals with verbal descriptions; brings in example specimens from nature for students to touch and examine; has students work in pairs to construct the Fibonacci sequence tactilely with simple manipulatives, such as dominos; instructs them how to plot the ratio points on a graph to determine the golden number; and allows them to explore the concept interactively through Web games. She also activates an e-text reader for students who need assistance in reading and processing information.

By offering flexible and varying opportunities that accommodate differing patterns of learning strengths, Ms. Dixon additionally provides a more stimulating environment for all students in the class. She more cohesively activates the recognition network, for example, through multisensory stimulation. She prompts associations across the strategic network by stating learning goals and directions clearly and by giving students instructive feedback. She presents and allows students to process information through varied and multiple learning tools: examples, illustrations, models, and games. She motivates the affective network offering by accommodating student's interests and learning preferences and by allowing them choices in how they process the new content and how they express what they have learned.

COGNITIVE ACCESS FOR LEARNING

Universal Design for Learning has its origins in an architectural movement called universal design (UD). Rather than "adding on" unattractive ramps to buildings for handicapped users, architects anticipate the needs of special populations and "build in" accommodations in the design stage (Curry 2003; Rose & Meyer, 2002). Universally-designed architecture and commercial products, critical for persons with disabilities, provide better access for all. Decoder chips in television design, for example, benefit people with hearing impairments *and* any viewer in a noisy restaurant, airport, or health facility. The curb cut in airport parking lots makes navigation possible for those in wheelchairs, mothers with strollers, people on crutches, and travelers pulling wheeled luggage.

Applied in the mainstreamed, regular classroom, universal design provides critical *cognitive access* to curriculum, materials, and instruction for students with learning challenges and enhances access to learning for all students (Howard, 2003; Kame'enui & Simmons, 1999). Central to this differentiation approach is the use of digital technology as a powerful and flexible scaffolding tool (Curry, 2003; Rose & Meyer, 2002). Digitized books and readings, portable word processors, electronic whiteboards, handwriting recognition tools, touch keys on computers, text enlargement, highlighters, translators, read-aloud features on computers, and other multimedia curricular materials and assistive technologies provide learning access for students who struggle with the traditional print versions of content. Numerous software programs and other resources are available for use as "cognitive tools" for screen reading, concept mapping, graphing, model construction, mathematical exploration, content organization, and other learning visualization opportunities (Rose & Meyer, 2002).

> **Digital Technology**
>
> The host of digital media tools that provide flexible scaffolding for cognitive access to learning. These include digitized books, computer-enhanced features for translation, highlighting, and text manipulation, as well as numerous software resources for screen reading, content organization, and visualization, to name a few.

EVOLVING CONVERSATIONS ABOUT DIFFERENTIATION

The UDL premise that all students can learn if given appropriate cognitive access and opportunity based on learning strengths is characteristic of fresh conversations about differentiation in contemporary classrooms (Rose & Meyer, 2002; Scherer, 2006; Tomlinson & Jarvis, 2006; Tomlinson & McTighe, 2006; Weiner, 2006). Deficit terminology such as "category," "label," "dysfunction," and "disability" is evolving into the more positive and action-oriented language of *inquire, discover, reframe, celebrate, build, nurture,* and *encourage.* As Scherer (2006) writes:

> The assumption that students' misbehavior and poor achievement are caused by learning disabilities or are the effects of growing up in poverty or of having dysfunctional families often precludes teachers

from recognizing their students' strengths and appreciating their own power to change the classroom dynamic. (p. 7)

Rather than measuring students' capabilities against a so-called "construct of normalcy," educators are focusing on the strengths each brings as learners.

Tomlinson and Eidson (2003) define differentiation as "a way of thinking about the classroom with the dual goals of honoring each student's learning needs and maximizing each student's learning capacity" (p. 3). It is an inclusive approach to curriculum design, instruction, and classroom management that anticipates and builds on students' learning strengths and supports learning needs. It is ongoing, formative, and assessment-driven as teachers monitor, match, and make learner-responsive instructional decisions and adjustments. It offers varied, multiple, and flexible options for students to learn, work together, and succeed academically.

Tomlinson (2001) describes the teacher's role in differentiated classrooms as one who "proactively plans and carries out varied approaches to content, process, and product in anticipation and in response to student differences in readiness, interests, and learning needs" (p. 7). She identifies several distinguishing elements of differentiated teaching:

1. Qualitative. Differentiated teaching is qualitative rather than quantitative. Students who have demonstrated mastery of a math skill, for example, do not need more practice but rather need to move to a subsequent skill. Conversely, a student who struggles with reading comprehension does not need fewer pages to read but needs support in organizing and making meaning of the content or reading material on a more appropriate level. The teacher's role is to adjust the nature of the task to match students' learning needs so that tasks are:

2. Grounded in Assessment. Differentiation is an ongoing effort to design instruction that opens the learning pathways of readiness, interest, and learning preference. Assessment in differentiated classrooms assumes multiple forms: diagnostic and pretests; informal measures, such as observation, journal entries, discussion, and group reporting; more formal formats, such as quizzes, tests, and papers; and more authentic products, such as mock trials, debates, and multimedia presentations. The teacher's role is to use assessment routinely to learn about students and to monitor their learning progress so that tasks are:

3. Student-Centered. In differentiated classrooms, learning experiences are relevant, engaging, interesting, and appropriately challenging. Students are encouraged to take responsibility for their learning and to make evaluative decisions about it. The teacher's role is to guide and provide direction, support, and feedback, as needed, to help students stretch, grow, and achieve success and competence, academically and socially, with tasks that are:

4. Approached in Multiple Curriculums. In any classroom, teachers have the "power" to make decisions about these curricular elements: (1) content, or

what students learn; (2) process, or how students make meaning of concepts and ideas; (3) product, or the way students demonstrate learning and understanding; (4) learning environment, or the use of physical space, time, and resources. In differentiated classrooms, the teacher's role is to vary these elements in ways that maximize student learning with tasks that are:

5. Flexible. Differentiation is an appropriate and flexible blend of whole-class, small group, and independent learning experiences. Students work in both heterogeneous and homogenous groups based on learning needs and interests. The teacher's role is to provide multiple and varying grouping options with tasks that are:

6. Dynamic. Differentiation is an ongoing inquiry into how students learn best in order to maximize learning and academic success. The teacher's role is to plan proactively to meet students' needs and to adjust and refine learning opportunities continually in response to students' readiness, interests, and learning needs.

Benjamin (2005) delineates several features of differentiation. These include pacing, the degree of structure provided by the teacher, the degree of independence given to the learner, the number of facets in a learning task, the level of concreteness or abstractness, and the level of complexity and depth. Depending on the needs of the learner, teachers can adjust each of these areas.

DEVELOPMENTALLY RESPONSIVE DIFFERENTIATION

Differentiation for adolescents considers students' developmental and individual learning needs. Developmentally, it is important to remember that adolescents are transitioning between concrete and abstract thinking. Younger adolescents are beginning to think logically and to see varying perspectives, yet they are still developing the metacognitive skills more characteristic of older adolescents and adults (Piaget, 1928). Psychologically, adolescents are in the process of defining who they are sexually, religiously, and politically (Erikson, 1968).

A unique goal of adolescent-centered differentiation is that they attain the cognitive strategies and the personal efficacy that enable them to manage their own learning. Adolescents are cognitively "ready" to think strategically and reflectively, the metacognitive capacities that are associated with the brain's developing prefrontal cortex. Learning efficacy evolves as adolescents recognize their personal learning strengths and acquire the cognitive strategies that further their learning goals. For adults, learning strategies are more practiced and automatic; however, for adolescents, these skills are in an experimental, formative state, often below their level of recognition. It behooves a teacher to provide multiple strategies for intellectual interaction and to

schedule time for processing and reflection. In response, adolescents recognize and learn in a manner that leads to success and personal competence (Crawford, 2007). This cognitive apprenticeship relationship among adolescents and teacher, described in Chapter 2, is an important element in differentiated classrooms.

THE LANGUAGE OF DIFFERENTIATION

Differentiation is shaped by the dynamic interaction of strategic instruction and learner engagement. It suggests that teachers concentrate on understanding the nature of the student in the design of curriculum, instruction, and assessment. Adolescents' individual learning differences are influenced by biology (gender, brain development, personal proclivities, and cognitive ability) and the environment (family, culture, opportunity, support structures, previous experiences, and prior knowledge). The teacher's goal is to design instructional experiences that build on and meaningfully challenge adolescents' knowledge, skills, and experiences, as well as to provide the necessary supports to help them succeed academically.

Differentiation involves understanding adolescents' varying learning needs as determined by their interests, readiness, and learning profiles (Tomlinson, 2001; Tomlinson & Eidson, 2003). These student characteristics are briefly described below.

- **Personal interests**, or what students enjoy learning, thinking about, and doing. The teacher's goal is to motivate by tapping into adolescents' interests and helping them connect with content that is relevant, intriguing, meaningful, and personally appealing. The teacher's goal is also to try and generate new interests in students.
- **Learning readiness**, or students' current knowledge, understanding, and skill set with regard to the content or skills a teacher is teaching on any given day. The teacher's goal is to make the learning task difficult enough to challenge at a given point according to students' readiness level and to provide the necessary supports that enable that student to succeed.
- **Learning profiles**, or students' preferred learning mode and intelligence strength. Factors that impact learning profile are learning style, such as audio, visual, tactile, kinesthetic preferences, and intelligence strengths (Gardner 1993, 1999, 2006) (see Box 1.1, "Intelligence Strengths"). Learning profile also includes differences in gender proclivities (see Box 1.2, "Gender Profiles"). The teacher's goal is to enable adolescents to learn in a natural and efficient manner, to recognize personal learning preferences, and to develop new avenues of learning.

Tomlinson and McTighe (2005) note that "[r]esponsive teaching necessitates that a teacher work continuously to establish positive relationships with

❖ **BOX 1.1 Intelligence Strengths**

Multiple Intelligences Theory

Linguistic. Understanding and use of written and spoken communication.

Logical/Mathematical. Understanding and use of logic and numerical symbols and operations.

Musical. Understanding and use of concepts of rhythm, pitch, harmony, and melody.

Spatial. Orientation and ability to manipulate three-dimensional space.

Bodily/Kinesthetic. Coordination of physical movement.

Naturalistic. Ability to distinguish and categorize natural objects and phenomena.

Interpersonal. Understanding and effectual interaction with people.

Intrapersonal. Understanding and use of personal thoughts, feelings, preferences, and interests.

Existential. Contemplation of phenomena or questions beyond sensory or empirical experience.

Source: Gardner, (1993, 1999, 2006). *Multiple Intelligences Theory*. New York: Basic Books

Triarchic Intelligence Theory

Analytical. Preference for linear learning based on memory ("schoolhouse intelligence").

Practical. Preference for learning within an authentic and relevant context ("contextual intelligence").

Creative. Preference for solving problems and creating innovations ("problem-solving intelligence").

Source: Sternberg, R. (1988). *Beyond IQ: A triarchic theory of human intelligence.* Cambridge, MA: Cambridge University Press.

❖ **BOX 1.2 Gender Profiles**

Gender and the Brain

Verbal/Spatial. Boys' brains are more spatial-mechanical and girls' brains are more verbal-emotive.

Optical/Neural. Boys' brains are more responsive to movement and girls' brains are more sensitive to color variety and fine sensory activity.

Frontal Lobe Development. Girls' prefrontal cortices (the part of the brain responsible for decision-making, literacy, and writing skills) are more active than boys', which tend to be more impulsive.

Neural Rest States. Boys' brains go into neural rest states that create a lower tolerance for boredom.

Cross Talk Between Hemispheres. Girls' brains structurally generate more communication between hemispheres enabling better multitasking abilities.

Natural Aggression. Chemical and neural differences associate boys with more competitive, aggressive, and less nurturing tendencies.

(based on findings from Blum, 1997; Gurian, 1996; Gurian & Stevens, 2005; Havers, 1995; King & Gurian, 2006; Rich, 2000; Sax, 2005; Taylor, 2002)

individual learners and come to understand which approaches to learning are most effective for various learners" (p. 18). Critical to the differentiation process is initial and ongoing assessment (Tomlinson, 2005). Teacher-designed inventories and surveys yield valuable early information about adolescents' interests, learning preferences, and attitudes toward subject areas. Quick-checks gauge reading comprehension, writing, and vocabulary levels, for example, while pre-unit assessments inform teachers of students' content-related knowledge and skills. Students demonstrate learning and understanding through varied and multiple opportunities for expression, including projects, authentic products, and performance-based debates or presentations.

The key to effective differentiation is to adjust the curricular components of content, instructional strategy (process), and assessment (product) continuously in response to adolescents' interests, readiness levels, and learning profiles. A discussion of these curriculum differentiation components with supporting examples in instructional practice follows.

CONTENT DIFFERENTIATION

Content, or the "what" of teaching, stems from several sources that include state and local standards, recommendations of professional organizations, curriculum guides, textbooks, and other curriculum materials in the learning environment. The teacher's challenge is to discern from these sources the essential knowledge, skills, and understandings that are *enduring* in the discipline, *relevant* to adolescents' lives, and *pertinent* to the unit or lesson under construction (Crawford, 2007). Wiggins and McTighe (2005) suggest that teachers choose concepts, "big ideas," and core processes that (1) have lasting value beyond the classroom, (2) are central to an understanding of the discipline, (3) have basis in students' misconceptions, and (4) potentially engage students' interests.

According to Maker (1982), the role of content differentiation, or modification, raises the expectation for students to learn and mentally organize knowledge in a more sophisticated manner. The focus is not on discrete facts, dates, rules, names, formulas, and words but on powerful organizations of content that are more abstract and complex and that are meaningful and transferable to students' lives and other learning contexts (Tomlinson, 2001).

Classroom Application

In planning a high school social studies unit, Mr. Wirt considers curriculum standards related to an understanding of the impact of social, cultural, and political context on human perspective. Adolescents may realize that historical accounts are based on personal interpretation; however, they may lack the ability to discern the validity of varying perspectives or the contextual factors that influence them. He formulates the following essential understanding that becomes the entire class's learning goal:

Human perspectives are shaped by complex historical, cultural, social, and political factors.

Mr. Wirt also determines that all students should develop the critical thinking skills to analyze and evaluate the credibility and authenticity of sources. He decides to use the Tiananmen Square incident of 1989 as the historical event to anchor the unit of study. He decides on the following learning goals for all students:

- Students will determine the validity and credibility of historical and cultural events by critically analyzing the varying accounts of the 1989 Tiananmen Square event.
- Students will think critically about the role of propaganda to distort the reporting of current events by examining news coverage in newspapers and on the Internet.

The next challenge for Mr. Wirt is to find ways that ensure student access to this essential understanding and skill set (Tomlinson & Eidson, 2003). Knowing the range of readiness, he selects texts and supplementary materials at varied reading levels. He considers the complexity, abstractness, depth, and breadth of resource materials and the academic needs of his students. He determines multiple ways for students to interact with and make meaning of, the content, including resources on the Internet. He builds in varying support or *scaffolding* strategies, such as highlighted text, videotapes and audiotapes, graphic organizers for note taking, and digests of spotlighted vocabulary and guiding questions. He realizes that translations of key concepts may assist students who are learning English. Box 1.3, "Example Strategies for Differentiation of Content," illustrates the content differentiation strategies Mr. Wirth uses to meets his students' varying readiness, interests, and learning profiles.

❖ BOX 1.3 Example Strategies for Differentiation of Content: Readiness

- Has students read from sources at **varied reading levels** about historical events (the Cultural Revolution, Mao's reign, the pro-democracy movement) that set the context for the Tiananmen Square incident
- Has students read conflicting accounts and excerpts in **different formats of varying complexity** of the 1989 Tiananmen Square incident in Beijing, China
- Builds in supports such as **highlighted text** and **translation**
- Supplements presentations/lecture with online **visuals** from the Encarta Learning Zone (photographs of Tiananmen Square, the protest, and a Beijing map) and **audiotapes**
- Allows students to work together as **reading buddies/partners**
- Provides students with **digests of key concepts** (for example, cultural and political context, propaganda, cultural stereotyping, cultural and historical perspective)
- Asks **task-specific questions**
  - Is there an account that seems closer to the truth?
  - Are there similarities in any other accounts?
  - How can any account be justified?
  - Why would Chinese officials be surprised at the protests?

(Continued)

(Continued)

- o How might the people's roles or ages influence the perspective?
- o Does the date of the reporting make any difference?
- Varies **levels of questions** during ensuing discussions
- Implements **reteaching methods** for students having difficulties

Interest

- Sets up an **interest center** with books, a computer, and list of pertinent sites for further exploration
- Uses **students' questions** to guide mini-lectures
- Uses **examples and illustrations** based on student interests and prior knowledge
- Develops a **learning profile**
- Shows a video of the news coverage of the 1989 Tiananmen Square incident for an **alternate presentation mode** (visual, auditory)
- Involves students in activities that involve choices related to **intelligence preferences**
- Has students research **other cultures** for instances of biased historical interpretations, such as Native Americans in U.S. history books or the debates over slavery between the North and South
- Provides **time** for students to think about and reflect on new content

Source: Adapted from instructional ideas in G. B. Crawford (2007). *Brain-Based Teaching With Adolescent Learning in Mind.* Thousand Oaks, CA: Corwin Press.

PROCESS DIFFERENTIATION

Just as students need multiple ways to take in new content, they need multiple and diverse opportunities to process, internalize, and consolidate new learning (Kaufeldt, 2005). Willis (2006) refers to the brain's need for periodic rests to process new material with the wordplay "*syn-naps,*" or "restorative breaks that are as important for successful memory retention as surprise, positive emotional state, sensory memories, and other relational memories" (p. 26). Furthermore, preteen adolescents can pay attention for approximately ten to fourteen minutes before they need time to actively process new ideas; secondary students, ages 13–18 can attend for approximately twelve to eighteen minutes (Kaufeldt, 2005). The stimulation, complexity, and frequency of processing opportunities improve the chance that new information will move from short- to long-term memory and be retained for future use.

Although the line between content and process is not a distinct one, it is useful to think about process as the time when students make meaning of content by applying it through a learning experience (Tomlinson & Eidson, 2003). When teachers differentiate for process, they find multiple and appropriately challenging ways for adolescents to think about, grapple with, and make sense of content related to important ideas and learning goals. A worthwhile learning experience is one that takes students beyond recitation of memorized information to "seeing how things work and why they work as they do" (p. 5).

Appropriate process experiences take adolescents to a more complex level of understanding, are designed with students' interests in mind, engage students' thinking at a higher level, and relate authentically to the real world

(Tomlinson, 2001). These learning tasks are further designed to align in complexity with students' readiness levels and to give students choices about where to put their learning energy. They additionally encourage students to use their preferred mode of learning, such as whether to work independently or collaboratively; whether to explore or express learning verbally, spatially, creatively, musically, or kinesthetically; or whether to work at a table, on the floor, at the computer, or at their desks.

Implications for Practice

Many adolescent-centered strategies support flexible and responsive processing (Benjamin, 2002, 2005; Crawford, 2007; Heacox, 2002; Kaufeldt, 2005; Tomlinson, 2001; Tomlinson & Eidson, 2003). A few are listed below:

- **Process partners,** when the teacher pauses and students discuss for a couple of minutes what they are learning with a preassigned partner. Prompts ask students to recall new ideas or concepts, orally summarize, or listen to the partner's interpretation.
- **Interactive response journals**, when the class is reading a common novel, for example, the teacher gives prompts varied according to students' interests or academic needs. For adolescents, free-response journals encourage more general or personal emotions to be expressed, issues related to health or relationships to be explored, or concerns about specific subject areas to be addressed. Math journals, for instance, enable students to reflect on how they approached and solved a problem, and associated questions.
- **Thinking maps or graphic organizers,** which give students a visual framework to display and organize ideas and information. According to Willis (2005), [g]raphic organizers coincide with the brain's style of patterning . . . to create meaningful and relevant connections to previously stored memories" (p. 16). These take the form of Venn diagrams; PMI (a graphic for listing the Positive aspects, the negative aspects or Minuses, and the Interesting aspects of an issue under discussion); decision matrices, flow charts, fishbone diagrams, T-charts, and multiple other organizing frames. Ed Ellis has published a wide repertoire of thinking maps ("think sheets") for content areas on his CD, *Makes Sense Strategies—The Works,* available at www.GraphicOrganizers.com.
- **Collaborative learning groups,** when small groups of students collaborate on a learning task. These include literature circles, when students read and discuss common readings; think-pair-share; Jigsaw, where students become experts on various aspects and "pool" their knowledge to construct a group understanding; and inquiry-based structures such as problem investigation, problem/project-based learning, and collaborative lab experiments.
- **Cooperative controversy,** in which students argue both sides of an issue. Adolescents could debate, for example, differing sides of relevant issues such as homeland security, immigration control, or deforestation.

- **Guided note taking,** when students are encouraged to take notes from an overhead or chart by adding their own visuals or personal touches.
- **Tiered assignments or parallel tasks,** in which students work at different levels of difficulty on the same key learning goals. *Tiered assignments* can be adjusted by challenge level, complexity, resources, outcomes, and products (Heacox, 2002). Students can be assigned to a tier or given a choice based on interests or learning preferences. Box 1.4, "Tiered Research Task for the Tiananmen Square Unit," provides an example of tiered research assignments.
- **Interactive technology,** including VCRs, DVD players, Internet, digital cameras, recorders, and presentation programs such as Hyperstudio, PowerPoint, and Inspiration.

Within each processing opportunity, teachers differentiate learning based on students' interests, readiness, and learning profile. In the Tiananmen Square unit, for example, Mr. Wirt differentiates for readiness in the following ways.

Tiered Assignments
A differentiation strategy in which adolescents work at different levels of difficulty on the same essential learning goals. Tiered assignments may be tasks or products. Tiers may be adjusted for complexity.

- The use of a **pro-con graphic organizer** helps students compare and contrast varying cultural and historical perspectives on the incident.
- The selection of URLs at **varying reading levels** facilitates student research.
- **Variation in the make-up** of cooperative learning groups, to include same and mixed ability levels, provides flexibility and support.
- A **tiered research assignment** provides differing levels of complexity.
- **Mini-workshops** offer students assistance on research skills, as needed.
- The use of **research partners** allows students to work together.

He differentiates by interest in these ways:

- Students take perspectives on varied issues related to **individual interests**, such as animal rights, mandated drug testing, the death penalty, stem cell research, bioengineering, censorship.
- Students conduct polls with peers on **selected, relevant issues.**
- Students write a persuasive letter or editorial to a pertinent source that reflects a **personal perspective** on a current issue.

He also differentiates by learning profile when he allows students to work together and independently and gives students choices in learning tasks and in the way they express their learning.

Processing for Transfer

Also important to adolescents' information processing and retention is their ability to connect new learning with events, phenomena, and circumstances

❖ **BOX 1.4 Tiered Research Task for the Tiananmen Square Unit**

With your research partner, follow at least three of the URLs below to read differing accounts of the Tiananmen Square incident. Prepare a one-page response based on the assigned task.

- Encarta Learning Zone, an interactive site that shows panoramic photos of Tiananmen Square: http://encarta.msn.com/media_701765791/Tiananmen_Square.html
- Tiananmen: The Gate of Heavenly Peace, contains several links to video and audio clips, articles, essays, and book excerpts on the incident: http://www.tsquare.tv/
- Berkeley University: News accounts from the US: http://globetrotter.berkeley.edu/clips/1989/XI1IIa.html
- Pekingduck Archives: A college student who participated in the event: http://www.pekingduck.org/archives/000063.php

Task One (for readiness level learners)

- Choose one of the accounts (Chinese, American reporter, student participant, others) and record the series of events about the incident on a flow chart diagram. Discuss why you think the account represents the person's point of view from a cultural or political perspective.
- Write this person a letter that contains at least three questions you'd like to ask related to this perspective.

Task Two (for advanced learners)

- Use a Venn Diagram to compare two differing accounts of the incident (Chinese, American reporter, student participant, other). Discuss why you think the account represents these persons' cultural or political perspective.
- Pretend you are a French reporter covering the event for your newspaper. Write your own account. Be prepared to justify your perspective.

Task Three (for grade-level learners)

- Use a Venn Diagram to compare two differing accounts of the incident (Chinese, American reporter, student participant, other). Discuss why you think the account represents these persons' cultural or political perspective.
- Pretend you are a reporter covering the event for your local newspaper. Write your own account. Be prepared to justify your perspective.

beyond the immediate learning context. Transfer of learning to new situations does not come naturally to adolescents. Their metacognitive skills for seeing the "big picture connections" are developing. Teachers thus are challenged to use explicit processing strategies to help them realize how the essential understandings that shaped a unit's design have lasting generalization in their own lives. Mr. Wirt, in the Tiananmen Square example, extends adolescent learning through reflective questioning and parallel activities. Examples of metacognitive questions that extend learning follow.

- Why do people see and interpret events differently?
- How do personal emotions affect one's perspective?
- Why is it important to consider historical and cultural context?

- What is important to consider in the critical analysis of sources?
- Do you think that what you read in the United States is always credible?

Mr. Wirt also heightens transfer by asking students to use critical analysis skills to contrast the coverage of current events in local, regional, and urban newspapers, or to compare editorials, articles, Web sites, or news coverage that give varying viewpoints on current issues such as the justification of the Iraq war, immigration control, or stem cell research.

PRODUCT DIFFERENTIATION

The term *product*, or learning evidence, generally refers to students' culminating demonstration of understanding the essential knowledge and skills of a unit or extended study. A product can be a unit test or a more authentic measure of learning, such as a presentation, a performance, a newscast, a newspaper, a museum exhibit, a musical interpretation, a multimedia presentation, a reenactment, a portfolio, a Web portal; a speech, a project or some other less traditional, alternative measure (Beamon, 1997, 2001; Crawford, 2007; Gardner, 2006; Tomlinson & McTighe, 2006; Wiggins & McTighe, 1998). Beamon (2001) offers several ideas suggested by teachers of adolescents. These include

- A travel brochure to show understanding of environmental concepts
- A trial simulation to show understanding of the judicial system
- Survival backpacks for a chosen biome to show understanding of the concept of survival
- A math bridge to show understanding of weight and equations
- A plan to attract businesses to a community to show understanding of economic principles
- A carnival game to show understanding of probability
- A children's book to show understanding of literary perspective and voice

Several elements are key to the design of assessment products for adolescents. First, the product is a meaningful, challenging, and a natural extension of the learning experience. Gardner (1993) proposes that a good assessment instrument be a learning experience in itself as students reshape and synthesize ideas within a real-world context. Second, the assessment conveys students' genuine understanding of or insight into important content knowledge. Third, guidelines and criteria for evaluation are clearly defined and understood, generally in the form of a rubric.

An additional critical element in product design is to allow adolescents to demonstrate learning in ways that reflect personal learning differences (Tomlinson & Eidson, 2003). Just as content and process are differentiated, products can be designed to vary or give students choices in response to readiness, interests, or learning profiles. Products can be tiered for depth or sophistication, as illustrated by Mr. Wirt's research task in the last section, or products can

Table 1.1   Differentiating Products for Multiple Intelligences

Linguistic	*Logical/Mathematical*	*Musical*	*Spatial*
Poem, Speech	Flow chart, Diagram	Song, Rap	Illustration
Letter, Essay	Strategy game	Musical score	Model, Diorama
Crossword puzzles	Graph, Checklist	Multimedia presentation	Comic book
Persuasive papers	Timeline, Sequence		Poster, Brochure
Intrapersonal	*Bodily/Kinesthetic*	*Interpersonal*	*Naturalistic*
Editorial, Opinion	Role play, Drama	Discussion, Debate	Travel brochure
Journal, Log	Interpretive dance	Opinion survey	Display, Collection
Reflective paper	Demonstration	Interview	Experiment

allow students to use a range of talents, interests, and preferences, including learning style and intelligence strength. Table 1.1, "Differentiating Products for Multiple Intelligences," provides ideas for products that differentiate for eight of the multiple intelligences.

POWERFUL LEARNING EXPERIENCES

Although the various elements of differentiation are discussed separately in this book, each constitutes an integral part of the learning cycle. Kaufeldt (2005) writes that "[t]his integrated approach to orchestrating content, grouping, environment, presentation, process, and products, when done well, should appear simply as a *powerful learning experience* to the students" (p. 116). Teachers who differentiate for adolescent learning structure meaningful, relevant, and appropriately challenging learning experiences that provide multiple pathways for students to acquire knowledge, demonstrate understanding, and be successful academically. Teachers who teach responsively understand the way in which student differences influence the way they learn. They develop curriculum, plan instruction, and structure the learning environment so that all students have access to, relate to, and make sense of essential ideas and skills and demonstrate understanding in personally meaningful ways. Accordingly, they support and maximize the success of all learners. If teachers hope to meet adolescents' changing and disparate developmental needs, they have no option but to create classrooms where learning opportunities are differentiated, and *all* students have meaningful opportunities to achieve.

Crawford (2007) suggests that effective teachers do the following for successful differentiation in the adolescent classroom:

- Inquire about students' personal strengths, preferences, and interests and incorporate these into planning.
- Learn about students' families and cultural backgrounds and honor these within the curriculum.

- Find out what students know or remember and help them relate to new learning by building connections.
- Look for broad themes in the content to include a wider range of students' ideas.
- Help students make a bridge between content and real life.
- Vary tasks to accommodate individual learning strengths and preferences.
- Structure groups that are flexible to validate interests and a range of learning abilities.
- Give assignments that differentiate for students' varying learning abilities.
- Allow students to discuss, explore, wonder, and question.
- Listen, guide, encourage, expect, push, facilitate, and challenge.
- Celebrate students' individuality by letting their thoughts be heard and their creativity flourish.
- Allow students to work, talk, and question collaboratively.
- Permit all students to delve into and better understand content through direct, meaningful, and relevant involvement.
- Challenge students to use knowledge in ways that make sense and a difference in their lives and others.
- Trust and guide students as they take ownership of their own learning.
- Respect and value students' differences and build on them so that they become more competent and confident in personal learning management.
- Enable students to expand the horizons of learning by interacting with resources in the local and global community.

DIFFERENTIATION DESIGN PRINCIPLES

Differentiation for adolescent learning capitalizes on the developmental and personal strengths these students bring to the classroom. It incorporates these six design principles.

Principle 1: Evaluation. Seek to know students' developmental and individual learning needs, strengths, interests, and preferences through initial, multiple, and ongoing assessment.

Principle 2: Expectation. Use assessment knowledge strategically to design meaningful curriculum and appropriately challenging learning opportunities for a range of learners.

Principle 3: Engagement. Use varied, multiple, and engaging instructional strategies for students to learn and demonstrate understanding.

Principle 4: Exploration. Organize flexible opportunities for students to collaborate, explore, and practice under guidance and feedback.

Principle 5: Extension. Promote learning management by making cognitive strategies explicit and structuring time for reflection and metacognitive extension.

Principle 6: Environment. Create and maintain a learning environment that is supportive for adolescents' intellectual, social, physical, and emotional development.

Figure 1.1 shows a visual of these six design principles. It is important to remember that these elements do not function in a linear manner. They are interrelated and interactive. Evaluation—in terms of the assessment of adolescents' interest, readiness, content knowledge, and learning preferences—is an ongoing process as teachers modify and adjust curriculum and instruction responsively. Expectation sets the curricular context of important disciplinary content that is differentiated through flexible access and cognitive supports. Engagement of adolescents' emotions, curiosity, and thinking is important throughout the learning experience. Exploration sets the mindset for intellectual inquiry and collaborative construction of meaning and understanding. Extension is likewise ongoing as teachers model cognitive strategies and coach students to reflect metacognitively and to transfer learning to other contexts. Critical to all learning experiences is a supportive learning environment in which students feel accepted and valued and where they have equitable opportunities to thrive personally and intellectually.

Figure 1.1   Adolescent-Centered Differentiation
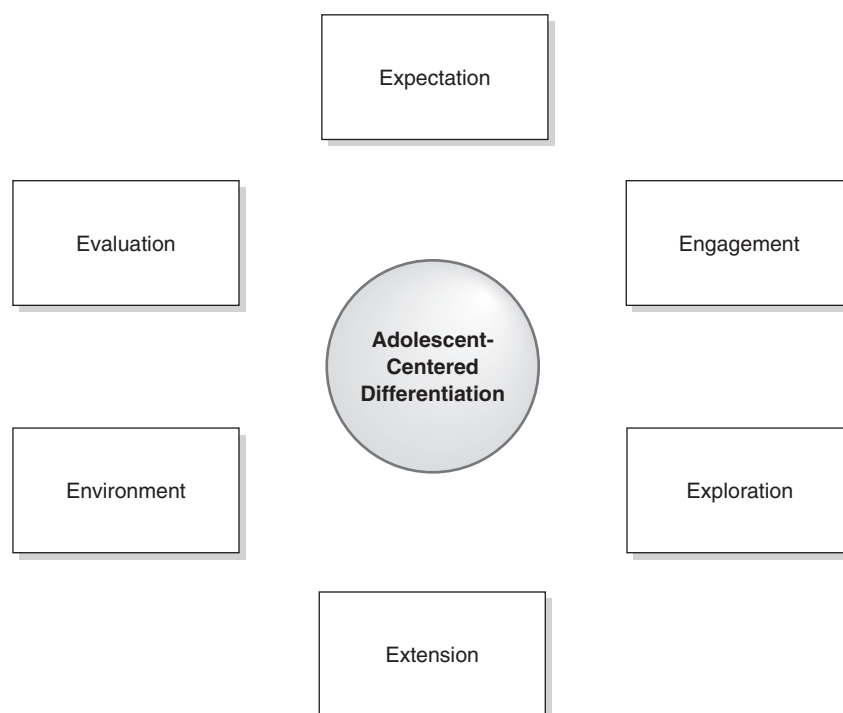
SUMMARY AND LOOKING AHEAD

Chapter 1 approaches the many and varied learning differences among adolescents that are contingent on hereditary and background experiences. It addresses brain research related to the differing ways adolescents' learning brains receive, process, and relate to content and classroom conditions. It defines differentiation as a strategic approach to curriculum design and

instruction that builds meaningfully and responsively on adolescents' developmental needs and learning strengths. It also, importantly, identifies six design principles that support adolescent-centered differentiation. It then introduces the language of differentiation through examples of content, process, and product and illustrates the differentiation strategy, tiered assignments, as used in student research. Other noted strategies that differentiate for adolescents' readiness, interests, and learning profiles follow. Many of these are illustrated in the following chapters.

- Varied complexity of reading levels
- Highlighted text and translation as scaffolding
- Varied supplemental materials for learning styles
- Varied questioning strategies
- Digests of key concepts
- Interest centers
- Use of examples and illustrations based on student interest and knowledge
- Mini-lectures based on students' questions
- Multiple Intelligences in products
- Reading partners
- Reteaching
- Alternate/multiple presentation modes
- Choice in activities and products based on Multiple Intelligences
- Cultural sensitivity and diversity
- Process partners
- Interactive response journals
- Thinking maps or graphic organizers
- Collaborative learning groups
- Cooperative controversy
- Guided note taking
- Tiered assignments or parallel tasks
- Interactive technology

Chapter 2 explores the relationship between adolescents' unique intellectual, personal, and social learning needs and how their brains generally function during the learning process. It illustrates with examples for classroom practice. It also examines pivotal findings from the field of neuroscience that shed light on the developing adolescent brain and associated cognitive and emotional maturity.