Making A Difference

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If American education is devoted to offering opportunities for *all* students to gain sufficient schooling to help them make life choices and become productive members of society, then *all teachers* must have the knowledge to make appropriate adaptations so that every student, regardless of ability or disability, can become an active participant in the learning process. This basic statement brings to the forefront the complex nature of the issues of teaching science to students with disabilities.

Most people’s conditioning comes from a multitude of experiences with family and peers, plus observing and interacting with others in a variety of settings. Interpersonal communication skills are reflected in a person’s ability to transmit and receive information from others. But the life experiences for most persons with disabilities are significantly different from those of the general population. Their opportunities to experience and fully adjust to the mores of the majority culture are usually much more limited. In cases of sensory and/or processing deficits, the disabled person may not process experiences in the same way as the general population.

Some things are changing. The personal computer has dramatically helped increase participation for persons with disabilities as new adaptations emerge from improved technology and engineering. This has allowed many persons with disabilities to greatly improve their receptive and expressive communication, providing greater possibility and frequent daily interactions with other people.

Because of the special challenges of social integration for people with disabilities, the educational environment is an ideal setting to blend together persons with physical, cultural, emotional, and intellectual diversity into a cohesive, mutually supportive group. Group synergism can become more powerful than the collective output of each person acting independently. In a democracy, this is what society is searching for and what businesses seek in their employees. Why shouldn't it be the essence of what we wish to accomplish in schooling? To accomplish these outcomes, the talents and abilities of *everyone* must be considered. The environment and interactions must be adjusted and modified to meet the capabilities and potentials of each individual.

Consistency is critical in nurturing social behaviors. However, persons with disabilities frequently experience inconsistency because adults and even peers often vary their interactions based on prejudices and attitudes in a social context. To perceive trust but experience avoidance can be a dehabilitating interaction for an individual. The result of inconsistent social overtures often creates signature feelings such as not trusting your dispositions of acceptance, or expecting the pain of avoidance if a social context changes. The long-term result often becomes to play relationships “close to the heart” rather than confidently reaching out toward collaborative opportunities. Yet skills of confidence and trust are the exact skills that enable people to advance professionally and move through the management hierarchy.

Most individuals with disabilities know the challenges and inconveniences they must face, and with appropriate accommodations, probably prefer to address them in a private manner. Inappropriate treatment by adults is a common daily experience for many persons with disabilities. Whether it is overt discomfort, being ignored or avoided, being the target of lower expectations and/or having their contributions marginalized, each experience has a way of saying "you don't belong." Perhaps one of the highest levels of courage are persons with disabilities who, in spite of constant bombardment with rejection signals and being undervalued, wake up in the morning and say inside "I will try again today." No one appreciates being rejected, and these dispositions are frequently transmitted in group situations, particularly when significant numbers of the people are unfamiliar with each other. Social experiences are frequently much more traumatic and have more long-lasting avoidance responses than physical challenges related to disability accommodations.

Highly effective teachers adapt and modify. Significant differences can be seen between teachers who teach groups of students and those who look at the uniqueness of each individual. Communication and understanding are needed for all students, but especially for those with disabilities. They do make the life of teachers more difficult and challenging because standard instructional materials are often not appropriate. The type and time of modification must reflect the context of the student's needs.

American education has a long-standing history of low expectations for students with disabilities. These expectations influence (a) the amount of time students with disabilities spend learning science and the amount of time they are actively engaged in investigation in the science laboratory, (b) the academic focus and quality of objectives, (c) the sequence and depth of the learning opportunities afforded to students, (d) access to knowledge and resources, (e) homework expectations, and (f) curriculum alignment. Common dangers students with disabilities encounter are the cumulative effects of sympathy and low expectations. A convenient teaching action is just to expect less from those who don't perform well on common group assignments. Similar low expectations occur by having the student with disabilities only be an observer during science experiments or by providing peer assistance in activities that require writing or fine motor coordination. When students realize low expectations, it may be the result of teacher decisions that sustain mediocrity in students.

In many cases the student with disabilities does not get to handle things because of teacher inconvenience, unwillingness to make adaptations, or just an overall lack of awareness and sensitivity of classroom teachers. Early experiences, extending throughout the school-age years, often instill in disabled students the idea that their role is one of a "passive observer" in an active learning setting. As a result, students with disabilities often become passive observers in activity-centered settings because their unique needs are not considered with sufficient positive regard. It is not surprising that a lack of exploratory experiences in childhood and adolescence becomes a barrier to later learning, particularly when the primary means of instruction are expository, verbal, or through print materials. Physical adaptations and emotional adaptations have a permeating importance for all settings and all individuals. In addition to making the curriculum more accessible, they communicate to everyone that all individuals are important, and we have different needs depending upon personal circumstances.

Teachers must make hundreds of decisions every day. In trying to cope with the intensity of multiple inputs, decisions are often made quickly, carried out, and forgotten. Ask yourself if your reactions and actions often become so automatic that you are unaware of your own thinking processes. On the other hand, expecting too much can be equally devastating. Many physical disabilities place a strain on a student's endurance and time. The student probably needs more rest, may take longer to get ready for school or to get set up for homework, and may find activities physically challenging that are routine for most students. Much depends upon the relationship between the student and the teacher in establishing an appropriate balance.

Teachers need skills as effective coaches who have the ability to enlist support, cooperation, and responsibility of all players. They develop a team synergism that accomplishes more than each individual contributor. Each individual is brought into the unit with some unique skills and responsibilities that will help bring about success. This is exactly what effective teachers also do. Their ability to instill in each child his or her worth and importance as a learner and to develop a class cohesiveness are critical teaching skills. These teaching skills help students remain persistent because they all feel important and appreciated. Effective schools have structure and order, a business like environment. Students in the school should have a place to be and a meaningful responsibility that is appropriate and challenging from the time they enter until the time they leave. Throughout the year, extra effort should be devoted to the process of contextual language instruction in an atmosphere of support, acceptance, and refinement for all students. Skills of communication require rigor and repetition. Proofreading, refinement, and precision in an accepting environment are essential skills in developing a growing, conscientious attitude about clarity and effective communication. All professionals must perceive these elements as joint and collective responsibilities.

Any practicing professional educator needs a sound understanding of the students served. Yet it is almost impossible for regular educators to keep up with the increasing number of students in their classrooms who have a disability label and to maintain familiarity with appropriate interventions for each of the disabilities. At one extreme, McGuinness (1989) described one third of all elementary school boys as an abnormal population because they are fidgety, inattentive, and inalienable to adult control. On the other hand, some believe inattention and moderately deviant behaviors on occasion are a normal part of being a child or young adult. As medical and behavioral models become more refined, along with increasing pressures of accountability that all students have successful learning experiences, more pressure and more responsibilities are being placed on the classroom teacher.

Legal changes have also mandated regular education for many students with disabilities. IDEA 2004 continues the prior IDEA protections in nondiscriminatory evaluation, individualized education, and least restrictive environment placement. Under IDEA the local education agency is responsible for determining first, whether the student has a disability, and second, the student's educational needs. However, few examiners and few special education personnel understand science well enough to determine educational needs within science classrooms or appropriate interventions during science lessons. Only through active participation from teachers of science will the educational science needs of students with disabilities be addressed.

To accomplish this goal, collaboration is essential. Without the leadership of the regular classroom science teacher, student needs will not be adequately served. In too many instances, especially where the student has a severe profound physical or mental impairment, classroom aides, who often have neither the expertise nor the experience, are primary decision makers regarding accommodations. This is a serious issue that must be addressed if equity is to exist in our schools.

Equity issues are important considerations. The extent to which females, minorities, and persons with disabilities feel a sense of equity importance and appreciation has a significant bearing on the climate and culture within the school community and in the way the culture is perceived by outside constituents. Schools tend to use middle class traditions, the majority of teachers are Caucasian and they tend to perceive white students as more capable – a well-intentioned but unexamined perspective that places students who are not middle class and white at a disadvantage Hale, 2001). Heshusius (2004), in writing on consciousness and fear of disabilities, states that “it is natural for us as humans to maintain the images that create a safe, stable, and socially desirable notion of ‘self’ for ourselves, fearing those selves that threaten those images” (p.286). Kozol (2005) affirms research reported in his earlier publications, that racism and social class marginalize minority students, particularly those in urban schools.

Equity concerning all of these groups are among the most challenging issues to our society. They simultaneously demand acknowledgment and response, but also foster resistance. Banton and Singh (2004) state, “No human being is reducible to one singular identity; we are indeed all - gendered, raced, classed- and nobody can escape the social construction of disability” (p.113). Mantsios (2000) believes we have the most stratified society among advanced industrial nations. Class distinctions exist in every aspect of our lives, especially influencing the quality of schooling one receives, health care and safety. Although a growing body of literature is emerging, the knowledge base about issues of diversity and equity is very limited.

Petersen (2006) investigated the intersectionality of gender, race, disability, and class in American schools. She presents a powerful case that by having several stigmatizing identities that oppression is often exacerbated. Vernon (1999), describes that, “one plus one does not equal two oppressions” (p.385), they can be experienced simultaneously or singularly depending upon the context. Peterson (2006) argues that individuals lives cannot be understood through only one aspect of identity, albeit gender, race, disability or class. An understanding on one’s experience can be understood only through a thorough inquiry into the multiple dimensions of one’s identity.

There is an increasing awareness that traditional science instruction favors male children without disabilities. The majority of persons involved in science related professions that receive their education in American schools come from middle level or high socio-economic backgrounds and from English-speaking homes (Gibbons, 2003). One area of consistency is that when teachers assume responsibility to engage all students the gap narrows and classroom achievement improves (Haycock, 2002). In a three year study involving a Latino students, Lee and Fradd (2001), reported that pre-unit and post-unit scores doubled when teachers employed the principles forwarded in the instructional congruence approach to teaching. Instructional congruence occurs when teachers mediate the nature of academic content and inquiry with consideration for language, cultural diversity, and disability (Lee and Fradd, 2001). The basic premise of instructional congruence is centered on teacher behaviors and choices. The essence of the concept is to teach through the minds of the learners rather than expecting to learners to adapt to the thinking processes forwarded by the teacher.

There are a number of ways that teachers can enhance instructional congruence for their students to enhance the learning of science concepts. One of the most basic is to include the utilization of hands-on investigations where students can work cooperatively and collaboratively with peers. Another is to allow and encourage conversation with other students, their parents and other professionals. A third is to provide assistance with the vocabulary and pre-requisite knowledge or skills. Fourth, to look at connections through literature and everyday life experiences relating to the concept being studied (Lee, 2004). Fifth, to establish personal relevance through the study of real world problems such as the study of infectious disease (Johnson, 2005).

Race, Gender, and Talents

In recent years other collaborative research supports the basic effect of school studies done in the late 1970's and early 1980's. In related publications Eggen (2002), Taylor, et al (2000), and

Zeichner (1996) note characteristics of teachers who are able to produce relatively high levels of student achievement in culturally diverse settings. These are:

- Teachers have a clear sense of their own ethnic and cultural identities.
- Teachers are personally committed to achieving equity for all students and believe that they are capable of making a difference in their students' learning.
- Teachers develop a personal bond with their students in a democratic and cooperative learning atmosphere.
- The curriculum is inclusive of the contributions and perspectives of the different ethno-cultural groups that make up the society.
- Scaffolding is provided by teachers that link the academically challenging and inclusive curriculum to the cultural resources that students bring to school.
- Parents and community members are encouraged to become involved in students' education and are given a significant voice in making important school decisions in relation to program, i.e., sources and staffing.

African American Students

African Americans are an ethnic group within mainstream America with their own culture that may affect their performance in science in unique ways. There may be special challenges in connecting the home, community and classroom science learning.

Teacher expectations, particularly for African American youth living in low socio-economic environments are lower than those held for other ethnic populations (Diamond, Randolph and Spillane, 2004). The danger exists in how teachers approach the learners. When students are approached as if they are less capable than their peers, they achieve less, are absent more often, and are more likely to drop out of school. There is a particular danger with grouping or tracking students. Tracking does not increase student performance but, in contrast, increases the potential for school failure and dropout (Pettit, 2006, p. 107). Diamond, Randolph and Spillane (2004), found that when African American children performed high academically compared with white counterparts they were considered an exception to the rule. If an European American performed poorly, he/she was considered an exception. When teachers have low expectations of students' academic ability they tend to give them less challenging coursework (Farka, 1996). These become coupled, teachers emphasizing student deficits and students perceiving a reduced sense of responsibility.

In investigating the thoughts, ideas and perceptions of an African American adult with a vision disability Peterson (2006), described her frustration with a domineering guardian who felt she had a right to unapologetically interject her ideas, thoughts, and opinions in a manner that overshadowed and contradicted what the individual was attempting to say (p.84). She states, "thus I came to understand Shana's inarticulateness not simply as a result of limited language skills, but "generally overlaid by other factors including a lack of self-esteem, learned habits of compliance, social isolation, loneliness and the experience of oppression (p.87).

The social context of the science learning experience may be an important factor for the African American student. Anderson and Stokes (1984), reported that Anglo families were much more likely to initiate educational interactions, where African American families waited for the child to initiate. This might be particularly important during the ages of 7-14 where a child grows in complexity as a person, where there is an increase in competency in many domains, and where there is a progressive integration into the society or culture Serpell, Baker and Sonnenschein, 2005). Differences between the language of the home and school can vary in conversational behavior (turn taking between an adult and child when conversing), motivation (whether a child feels rewarded by either the family or teacher), and learning style (learning by observing before performing), Reese, et. al., (2000). A lack of consideration and communication often results in consternation and confusion that inhibits the educational process. Information flow from the teacher to the student and to the family members working toward consensus is vital. In a study by Linek, Rasinski and Harkins (1997), over 90% of teachers recognized the importance of involving parents, yet less than 5% supported involving parents as partners. Teachers that do not make an effort to know the family are failing to know the student.

Confusion is particularly paramount in an inquiry based science curriculum where teachers focus on process while the student and parent believe that a good deal of rote learning is needed to develop proficiency. Eccles and Harold (1996) noted that while teachers claim to frequently encourage parents to assist children in learning, they seldom offered suggestions on what parents should do. This often results in parents being unsure of teachers' expectations for their child's science learning. There tends to be little consideration of children's ideas that investigate home-school science connections (Shields, et.al., 1983).

In her study of four adult African American with disabilities, Peterson (2006) illuminates the challenges and navigational techniques and adaptations employed by the individuals. They constantly struggled with low expectations by educators and guardians. They described acts of resistance that were "slightly oppositional" and "quietly subversive" in response or reaction to the dominant ideology in the classroom. Examples included purposefully ignoring directions, intentional lack of participation, engaging in distracting techniques, and intentional tardiness particularly after physical therapy (p.150). Collins (2000) describes adaptive behaviors of persons located in an oppressive culture as "working the cracks" to initiate change through pecking at "cracks and fissures that represent organizational weakness" (p. 282). Peterson notes that in her research the individuals exhibiting semi-conscious acts of resistance possessed a developing understanding of the oppressive nature of their circumstances, but were unable to fully explain their intent or articulate a desired outcome at the time the experience occurred (p.153). An element associated with fewer African-Americans in science fields is African American student performance and participation in the mathematics curriculum. As a group, they perform less well on standardized measures and are less likely to select advanced mathematics courses or electives in mathematics at the high school level. Mathematics is often a "gatekeeper' for advanced science courses. African American students often find mathematics more difficult as do those from certain other ethnic groups. This is associated by some as due to language and learning style differences (Orr, 1987; Delpit, 1995).

In a study by Msengi (2006), he summarizes that triangulating information between the adult family member, the student and the associated teacher can be a tool for a shared understanding leading to improved home-school relationships. He states further states that these efforts can build on family strengths and provide flexible venues for exploring alternatives rather than dwelling on conflicts between the adult family member, the student and the teacher.

The following are classroom suggestions for addressing the unique needs of African American students:

1. Students achieve more when teachers provide hands-on experiential learning opportunities for students in science (Simpson, 20002).
2. Higher student outcomes are achieved when students are allowed to work together in cooperative groups (Hilberg and Tharp, 2002).
3. The availability of a mentor to help the teacher address circumstances unique to the

cultural context of the community is beneficial to student learning (Starnes, 2006).

4. Walking through investigations on occasion to guide students through the thinking process can improve student motivation and engagement (Curtin, 2006).
5. Initiating family engagement and providing guidance on what parents can do to help in science learning yields improved student performance (Sonnenstein & Schmidt, 2000).
6. Using examples, taking time to explain and not giving too many directions have been found to improve the student-teacher relationship (Curtin, 2006).
7. Exposure to key concepts and vocabulary is important early in the lesson. More effective teachers work to bring in language connections and student experiences associated with the concepts (Krashen, 1994).
8. Time to practice particularly through games and exposure to multiple intelligence activities resulted in improved student engagement and improved student attitudes towards their teachers (Curtin, 2006).
9. Walking around the classroom, seeking out student responses instead of waiting for students to raise their hands, and teachers who encourage students often are more effective (Starnes, 2006).

American Indian Children

The education profession is dominated largely by white teachers with a higher predominance of females as we progress from high school to the education of young children. Starnes (2006) iterates clearly that what teachers don't know significantly impacts their effectiveness as educators. She notes that we don't recognize or respond to the chasm that exists between customary methods and curriculum and the way children from other cultures learn. In addition the little we know about the history, culture, and communities in which they live comes from white educators. A special challenge exists because each culture and each community is unique. The hardships associated with efforts at extinction, slavery, forced migration, forced religious conversion and disease are all imbedded in historical roots. This are complicated with contemporary social challenges involving poverty, unemployment, teen pregnancy, substance abuse, higher than average dropout rates, and higher than average levels of suicide.

There are teaching practices that are significantly more effective and they are highly congruent with best practice in science education. Classroom teachers that employ hands-on, experiential learning in an informal, flexible learning environment achieve better student learning outcomes (Gilliland, 1999 and Simpson, 2002). Collaborative processes where students are given opportunities to work together yield both higher learning outcomes and more positive attitudes (Hilberg & Tharp, 2002). Rhodes (1994), notes the value of informal classrooms where teachers act as facilitators as being beneficial to native students. Cajete (1999), suggests that teachers present the whole concept before focusing on segments and details when working with students from other cultures. Pewewardy & Hammer (2003), note the value of reflective processing where students are given opportunities to build new knowledge out of prior learning. In a study of cognitive styles Riding and Rayner (1998) reported that for visual learners their performance almost doubles with information that includes text and illustration as opposed to text alone. Whenever possible bring in visual aids or models.

Specifically reflecting on her work with Native American youth, Starnes (2006) offers a number of suggestions for teachers. First and foremost is the need to seek out a mentor who will help guide decisions through the cultural and historical circumstances unique to the cultural context where you are teaching. Teachers need to attend appropriate cultural, social and sporting events so the community senses there is intent to be connected. When possible bring in responsible elders as speakers to students and in other roles where they can enhance school-community relationships and communication. Non-native teachers need to become educated abut history from the perspective of the community and examine difficult realities where one looks at injustices committed against people by people or by government policies and practices, both historical and contemporary. There is a need to create materials and activities specific to your curriculum because there is a general unlikelihood that commercial materials exist. Lastly one must be patient and expect different cultural issues to emerge again and again. One must understand that it takes time to change generations of cultural interactions and mistrust.

English Language Learners

For students who do not experience the English language as young children one can expect delays in their conceptual understanding of science. These delays exist even in students that appear to have good social verbal skills and effective communication with everyday vocabulary. One of the greatest challenges for teachers relating to English Language Learners is that of engagement. Without direct communication with the learner(s) the learning gaps that are likely to occur makes science an insurmountable hurdle. The following suggestions are offered to guide instruction with English Language Learners.

In an ethnographic study of a group of largely Hispanic students from Mexico, Curtin (2006) reported that the students liked school in the United States. They felt materially comfortable and safe, even though they attended an urban school in a low-socioeconomic section of a large city. One area of difficulty they noted, even though they felt fluent in English, was a struggle with the content and vocabulary in science.

Without providing time to communicate with the student(s) in private outside of the regular classroom, it is likely that instruction will result in numerous unforeseen problems both in learning and in relationships. A critical aspect of learning is a caring teacher, one who understands students' issues and concerns, one who provides the necessary supports for success, and one who holds high expectations.

In general, prior exposure works more effectively than remediation. Prior to introducing the unit to the entire class, it is important that the student(s) have an opportunity to preview key concepts and vocabulary. When possible, it is advantageous if this can be done in their primary language, but it can also be done in English.

Sharing the desired learning outcomes and vocabulary prior to instruction is valuable to both the teachers and students. Pinpointing vocabulary, posting webs, and framing concepts and applications on charts and word walls can provide a reference and reinforcement. Pre-assessment of all students using language "buddies" is often a helpful strategy. In this strategy it might be possible to pair the student with another student who has bilingual proficiency who can translate and converse in the native language. If this is not possible parent volunteers or teachers aids might be able to assist.

Krashen (1994), offers Specifically Designed Academic Instruction in English (SDAIE) strategies for helping English Language Learners in the science classroom. These strategies include speaking clearly and at a slower pace, using gestures and facial expressions, using concrete materials and visuals, avoiding idiomatic expressions, and using student-centered activities.

Exploration using heterogeneous cooperative groupings is critical. As student work together enables the English Language Learner to tap into the strengths of other learners. Lessons should be organized so that students can express themselves through drawings, short phrases or mathematical data reporting where the English Language Learner is less likely to be marginalized.

When developing the concept try to “chunk” the information into 10 minute segments, following each “chunk” allow for short times of discussion with a neighbor to share what was learned. Allowing students to speak out enables them to work out an understanding of the material and remember the content (Hansen, 2006). This can be supplemented with multi-media opportunities such as videos or interactive software to help scaffold student learning. For older students opportunities to use the internet and investigate sources in their native language can be very helpful.

Curtin (2006) shared numerous suggestions from in-depth conversations with adolescent English Language Learners. They described good teachers as ones that used examples, explained a lot, and did not give too many directions. They spent a lot of time focusing on their actual teaching strategies. They did not “blame” students for not learning and were always seeking new teaching strategies. They incorporated games, used hands-on approaches, and had knowledge of multiple intelligence theory. They walked around the classroom and sought out students instead of waiting for students to raise their hands. They focused on faces and non-verbal communication from teachers.

When Curtin (2006) asked students about teaching practices they preferred they noted teachers who knew their names and sometimes incorporated elements relating to their culture in their teaching. The students enjoyed group work and opportunities to seek help from other students without getting in trouble. They especially appreciated models and concrete examples and visual supports. Examples and opportunities to practice were often mentioned by students as desirable. They perceived teachers that used interactive instructional approaches as being much more congruent with their leaning needs than teachers that employed more didactic practices.

One element that emerged from Curtin’s (2006) research with English Language Learners was a desire by students to be “walked through” a problem rather than being required to figure it out on their own. This poses an interesting dichotomy faced by science teachers in general. Students prefer inquiry strategies, cooperative heterogeneous learning groups and hands-on learning but also want the teacher to guide them through problem solving. This poses the universal challenge of how do educators develop higher-order thinking and independent learning skills in students and at the same time sustain a connectedness with the students in the process.

Assessment and grading often becomes especially difficult for English Language Learners. In traditional forms of objective assessments the students do not have an opportunity to clearly communicate what they have learned and are able to do. It doesn’t take long before motivation wanes when there is incongruence between one’s understanding and your performance as perceived by an external evaluator (teacher). The teacher must always look for ways that English Language Learners can demonstrate performance. Authentic assessment though an hands-on inquiry experience is a good strategy as a culminating activity. Other suggestions noted by Hansen (2006) are projects, drawings, labeled diagrams, posters and products.

Gender

The last two decades have reflected substantive changes in the percentage of women pursuing degrees in science and engineering. A National Science Foundation Report notes that in 2001 women received over half of the bachelor's degrees and 37 percent of doctoral degrees in science and engineering. However, problems associated with women in science persist that require a continuing focus and attention of teachers and professors.

Women indicate declining interests in entering STEM fields beginning in the 7th grade (VanLeuvan, 2004), and they are more likely to drop out of science majors after entering a college or university (Vidal-Arwin, 2002). Relative to the percentages of women with degrees in STEM, there are significant under representations in the upper echelons of the scientific community and in high level faculty positions. With regard to the workforce, the disparities in participation between groups remain striking, as noted in NSF figures (NSF, 1999, p. 3). From the standpoint of gender gaps:

- Women are 51.1 percent of the population, but only 22.4 percent of the science and engineering workforce.
- Men are 48.9 percent of the population, and 77.6 percent of the science and engineering workforce.

Women scientists report more sexual harassment and gender discrimination in the workplace (Settles & Cortina, 2006). In the university environment women scientists are more likely to note a hostile and chilly atmosphere for women on campus, an unconscious bias towards women concerning promotion, and the inability of universities to deal with balancing families and work (Reitz, 2005).

There is no evidence that girls are born less inclined to mathematics or mechanics than boys, but there is strong evidence that society believes this to be the case and encourages a division between boys and girls. Classroom attitudes of teachers, books written for children, and subtle but constant parental and societal pressures persuade children that boys are better at science, engineering, and mathematics than are girls and that girls are better with words than are boys (Vetter, 1996, p. 30). Vidal-Arwin (2002) reported that some teachers have negative biases towards women's abilities in science. Surveyed students indicated that women's contributions were rarely discussed in science classes. Comments from female students indicated some disliked the mathematics and the hard work required (VanLeuvan, 2004). Numerous studies have focused on the unresponsive downright "hostile climate" for girls and women in math and science classrooms, from the precollege level through graduate school and into the workplace (Sadker and Sadker, 1993). Girls with disabilities face double discrimination. They are hit with the bias that girls can't do math and science and that people with disabilities can't do math and science. This is compounded by a perception that somehow their disability makes them weak, needy, incompetent, or dependent, which often translates into protecting them from challenging work and learning (Wahl, 2001).

VanLeuvan (2004), in a survey of girls grades 7-12 found that they liked the discovery and using mathematics, and they had positive views regarding STEM careers. Regarding practices that make a difference, women noted a positive non-sexist climate and effective leadership (Settles & Cortina, 2006). Students noted the presence of female faculty, mentorship, research opportunities, cooperative rather than competitive learning environments, demonstrated appreciation for women's participation in science, and emphasis on programs to build pre-college mathematical skills (Vidal-Arwin, 2002). In a survey of women science majors, over 90 percent of the women had a guide of one type or another and that guides during college were more influential than guides prior to college (Downing & Crosby, 2005).

Girls have strengths that are from their talents and form a perspective somewhat different from their male counterparts. The following strategies, offered by Wahl, 2001, are ways to put these principles into practice.

Strategy 1. Encourage girls to question, explore, and challenge. Inquiry is fundamental to good science and good science education. It is a means of both motivating and engaging girls and necessary to achieving high quality outcomes in math and science because it lays the groundwork for serious and deep investigation. Encourage girls to ask questions, identify questions worth pursuing, and persist in the investigation; to take intellectual risks; to make mistakes and try it again in the quest for understanding; to get messy; to persist even in the face of demands from others for attention and service. Support girls to resist traditional socialization that values being neat, getting the right answer, and being compliant and unquestioning. Help girls – and boys – to challenge constraining stereotypes about who can do math and science and who can be a scientist.

Strategy 2. Keep girls in the science track – and change the tracks. Make sure girls are enrolled in the most advanced sequence of math and science courses possible and have the support to succeed. Consider eliminating tracking and segregation from math and science education. Clearly, these suggestions require much more than what a single teacher can accomplish alone, but it is essential that educators, individually and collectively, speak out and become a force for change in schools, districts, and states.

Strategy 3. Rethink teaching and classroom organization. Different people learn in different ways, and many people learn best when taught using more than one approach. You want girls to use all the senses they have available to them in exploring science – touch, sound, sight, smell – and to invent new ways to explore.

Similarly, make it clear that there are multiple ways of solving problems. Traditional approaches to math and science have sometimes implied that there is only one correct approach to an answer. Reformed math/science education emphasizes children developing and explaining their own strategies, proposing their own research designs, and inventing their own problem-solving algorithms.

Don’t make time an issue when it is not central to the math or science concept. It is true some students may need extra time. It is just as likely that other students need extra time as well, yet most classrooms, especially math classrooms, credit the quickest and the first. It is not a matter of slowing a whole group down but of structuring the learning process so that each student can proceed at his or her “right” pace.

Develop cooperative relationships for teaching and planning among specialists and teachers. A promising approach is collaborative teaching, bringing together the expertise of special education teachers with that of science and math educators. Use cooperative learning and peer tutoring, and tap students’ talents to share what they know with each other.

Strategy 4. Create networks and connections. Decreasing the isolation of girls, showing them that there are others like them who have been successful in math and science, and providing them with networks for support can go a long way toward helping girls with disabilities persist in science. Connect girls to mentors, role models, and each other around the experience of math and science. Expose them to careers and real life applications of math and science through field trips, partnerships with industry, internships, and opportunities to engage in serious research and exploration.

Lesbian, Gay, Bisexual, Transgender, or Questioning

It is important that educational environments accept the responsibility of all of the students in their care. One aspect of uniqueness that is unsettling for many, somewhat because it often transcends religious or moral convictions, is the issue of homosexuality.

Persons with disabilities who develop new feelings based upon their sexual awakening and physiological development can often feel that they are in love-feelings that can make them feel uncomfortable and confused, not knowing how to act or react. This becomes even more complex when associated with being identified as gay or lesbian,

The responsibilities of teachers and educators cannot be ignored in this regard. In addition to issues of social adjustment and mental health there are significant issues regarding safety and wellness. While some educators may feel uncomfortable in addressing these issues based upon their own fears or beliefs, it is a professional responsibility of educators, in all positions and at all levels, to provide a safe and supportive environment for all students.

In a survey conducted by the Gay, Lesbian, and Straight Education Network (GLSEN) in 2003, 64.3 percent of Lesbian, Gay, Bisexual or Transsexual (LGBT) students reported feeling unsafe at school because of their sexual orientation. In the same survey 82.9 percent indicated that faculty or staff failed to intervene when homophobic remarks were made. In terms of violations, 84 percent of LGBT reported being verbally harassed, 91.5 percent hearing homophobic remarks frequently or often, and 39.1 percent report being physically harassed because of their sexual orientation (Sims, 2003).

The trauma, trials and tribulations can be a summed up in a statement contained in an article by (Bailey, N., 2005), she states:

> The shame and ridicule and the fear of physical attack make school a fearful place, resulting in frequent absences and, too often, academic failure. These youth spend an inordinate amount of energy determining how to get safely to and from school, how to avoid the hallways when other students are present so they can avoid verbal and physical harassment, figuring out where they might be safe in the lunchroom or the locker room, and which restroom they can use and when.

Schools must represent the social and academic mores we want society to emulate and must provide a safe and equitable environment for all students and all adults. Teachers and administrators have a professional responsibility to oversee all aspects of the educational context and when they do not intervene, they give tacit assent to perpetrators and they marginalize the victims. A few suggestions offered by N.J. Bailey, 2005, are:

- Provide and require professional training for all adults in the school to learn and understand about LGBT needs, to become aware of responsibilities concerning their rights and well being, and to develop skills to meet their needs.
- All professionals must act assertively to prevent harassment, demeaning statements, demeaning gestures, or isolating maneuvers by individuals in the school regardless of the place or time.
- Ensure that there is at least one person in the school that is a well trained safe person to whom students can turn and get accurate information abut sexual orientation or gender identity. In some cases this may be a person outside school but all professions in the school should be knowledgeable about this human resource.
- Examine the school curriculum to look at ways to appropriately incorporate history, literature and role models from the LGBT community to forward a message, just as we

need to do will all other marginalized groups, that in America everyone can live a successful and productive life.

- Examine libraries and multi-media resources to ensure that there is a solid and age-appropriate body of information and literature, both fiction and non-fiction relating to sexual orientation.

In schools where there are initiatives relating to alleviating discriminatory actions towards students with disabilities there are significant differences. The average grade point of LGBT students is more than 10 percent higher, they are 40 percent less likely to skip school, and they are twice as likely to report that they intend to go to college. Equitable education ensures that everyone is valued and appreciated for the qualities they have without consequences by those that might be hypocritical, prejudiced or biased because of their own beliefs.

The following are classroom suggestions for addressing the unique needs of LBGT children:

1. Provide and require professional training for all adults in the school (Bailey, N., 2005).
    a. Learn and understand about LGBT
    b. Become aware of responsibilities concerning their rights and well-being
    c. Develop skills to meet their needs
2. All professionals must act assertively to prevent harassment, demeaning statements, demeaning gestures, or isolating maneuvers (Bailey, N., 2005).
3. Ensure that there is at least one person in the school that is a well-trained safe person to whom students can turn and get accurate information about sexual orientation or gender identity (Bailey, N., 2005).
4. Examine the school curriculum to look at ways to appropriately incorporate history, literature, and role models form the LGBT community to forward a message, just as we need to do with all other marginalized groups, that in America everyone can live a successful and productive life (Bailey, N., 2005).
5. Examine libraries and multi-media resources to ensure that there is a solid and age-appropriate body of information and literature, both fiction and non-fiction relating to sexual orientation (Bailey, N., 2005).

Gifted and Talented

With the implementation of state-wide testing mandates and No Child Left Behind legislative policies one of the most vulnerable groups are the students with above average abilities and giftedness. There are dangers of being exploited as aids and tutors for less able students, of being marginalized because the elements in the curriculum reflect things that they already know and are able to do, and difficulties they themselves encounter in the way they are perceived by peers and teachers.

Gifted students often have to balance differences in development from social norms, for example their intellectual understanding and problem solving abilities may be much better developed than their social skills and physical maturation. Scholastic achievements may result in more busy work by the teacher or isolated study that alienates them from classmates and peers. Teachers might resent domination in discussions or distractions because the student finishes assignments too quickly. The gifted student may resent additional demands particularly if they come from multiple classes where teachers do not communicate among themselves.

The most important element in creating an appropriate balance is honest and substantive conversation with the student. A teacher needs to assess the current level of student performance, engage in dialog about learning experiences that are compatible with the skills of the student and that he/she is willing to do, and develop a plan so that an appropriate level of challenge continues throughout the year. Most importantly it is important to discuss the balance between empowerment and responsibility with the student, with frequent checkpoints to insure that the outcomes are positive for the student and compatible with the educational program of the school.

Common practices include compacting the curriculum to avoid boredom and allow the student freedom to enrich his/her learning experiences, presenting an educational program with different levels of challenge where students have some freedom of choice, using cooperative learning and allowing groups to engage in more sophisticated problem solving or creative endeavors.

Lynne Bailey (2005) offers an engaging narrative of challenges and opportunities associated with a gifted early adolescent student. She shares some of the dilemmas in his personal experiences and balancing academic and social relationships. She describes that she had set high expectations and was proud of the impeccable work of the student. However, at a time when she was feeling a sense of pride about shaping a challenging curriculum she received an e-mail from his mother expressing concerns about his workload and that he had no time to play, run, or spend time with his family. In following up she found out that several of his teachers had also added multiple end of the semester projects and reports. She describes how she became alarmed and frightened about the intense young man that was involved in so much activity, both curricular and extra-curricular.

She took time to interview the student and get his view on the situation. Through conversation she was able to resolve elements with the student and achieve a level of moderation with the student. L. Bailey (2005) states, “Only after much clarifying conversation was I able to attempt to address some of his instructional needs in a productive manner.” She makes reference to Kaplan (2003) who notes that we should avoid thinking about one pedagogical approach for students with special talents. Each student and each context involves different considerations that relate to the context of the school, the nature of the subject matter, and the attributes and needs of the student. Following are some suggestions offered for gifted and talented students in science and technology:

- Speak frequently and frankly with students about their progress in and out of school (Bailey L., 2006)
- Work to achieve balance and moderation in structuring curriculum for the gifted student (Bailey L,, 2006)
- Communicate with other teachers, all of them (Bailey L., 2006)
- Thoroughly assess the interests of the student in and out of school
- Encourage risk taking and provide autonomy (Collins, Brown & Newman, 1989)
- Give pre-assessments so that students who actually know the material do not have to repeat instruction (Johnson, 2000).
- Employ cooperative learning and allow groups to engage in more sophisticated problem solving or creative endeavors. (Bailey, 2005)
- Allow opportunities for curriculum compacting, and allow students w freedom to enrich their learning experiences. (Reis, et.al., 1993)
- Establish early and continuing communication with the student’s family. (Bailey L., 2006)
- Include thematic, broad-based integrative content whenever possible (Watters & Dizmann, 2003).

- Modify content by allowing students to learn concepts at their own pace (Watters & Dizmann, 2003).
- Provide temporary problem solving support through scaffolding (Collins, Brown & Newman, 1989).
- Provide coaching to help with the problem solving process (Collins, Brown & Newman, 1989).
- Provide units, activities or problems that extend beyond the normal curriculum (Johnson, 2000).
- Provide access to male and female mentors (Johnson, 2000).
- Provide activities that can be done individually or in cooperative groups, based on student choice (Johnson, 2000).
- Don't ignore, in fact seek out, concrete experiences (Johnson, 2000).

Motor/Orthopedic Disabilities

Definition

The term "motor/orthopedic disability" encompasses a large number of impairments that have a significant impact on a person's life as a result of problems with the functional or structural aspects of one or more body systems or structures.

Science educators can gain information from several school staff sources to help students with motor/orthopedic disabilities succeed in the science classroom. For instance, take time to analyze the physical setting of the school and other learning locations. With input from student(s) with disabilities, you can determine barriers and hazards that could potentially impede students with motor/orthopedic disabilities. The school nurse and student(s) with disabilities can provide information on the constraints and side effects of medications to help science teachers understand any variance in student behavior. Special education personnel and other school specialists can help science teachers set appropriate expectations for academic and society tasks for the students. These resource people also often know how and where to obtain assistive technologies or access devices. However, if science teachers contact assistive technology agencies directly, they can become familiar with the specialized equipment.

Three categories of assistive technologies are described below.

Mobility devices: power wheelchairs, sonic guides, visual enhancement devices, and devices that can manage muscle movement through electrical stimulation. Robotics or computer interfaces for data collection and recording can provide opportunities for laboratory participation and, in many cases, laboratory independence for students who were previously denied access.

Augmentative communication systems: technologies that modify speech output or display words for persons with limited or unusable speech, closed captioning technologies, descriptive video, and multimodality output devices.

Sensory devices: reading devices for persons with visual impairments, science probes and other data collection tools with digital input.

Classroom Accommodations for Students with Motor/Orthopedic Disabilities

Oftentimes, classroom accommodations do not require elaborate modifications, merely a few well—planned adaptations, as the following suggestions demonstrate.

- Examine accessibility to materials and movement needs of the student
- Provide a supportive peer assistant (preferably someone that has had the class previously) or adult aide.
- Allow extra time for student and peers to continue with activities of choice outside of regular school day or at home.
- If student has limited motor control, consider tools or supports to serve as aids; have students work in groups.
- Provide a computer with software for the student to record observations and responses.
- All aisles should be at least one meter wide.
- Review work areas for appropriate height and accessibility of supplies and equipment.
- Examine trafficking needs of the student.
- Review classroom environment to ensure the student has appropriate access to peers for socialization and cooperative learning groups.
- Provide accessible means of reviewing drawings, charts, graphs, and/or models.
- Examine testing area for comfort of the student.
- If physical response is difficult, provide an assistive responding device.
- Provide low-force micro-switches for lighting, if appropriate.
- Look for adaptive software, keyboards, special switches, touch screen, and other special equipment.
- Alter size of equipment and provide handles or supports on supplies.
- Be especially careful if the student does not have good tactile sensory receptors. Severe burns can occur from hot water, chemicals, heat sources, etc.
- Plan appropriate breaks.

Science Lab and Field Experience

The student with impaired mobility needs to have easy access to equipment including computers, materials, safety devices, and other services such as restrooms, ramps, elevators, telephone, and accessible doors and exits. The student also needs enough aisle space for lateral movement and maneuverability. Positioning a wheelchair parallel to the lab bench and fume hood is generally restrictive, although some students prefer it. Ideally, a workbench should have an opening underneath that allows a student in a wheelchair to be closer to the work surface. Or a platform could be used to raise the student to a more compatible height with the bench top.

Every teaching laboratory should have at least one adapted workbench. The basic requirements for a laboratory work station for a student in a wheelchair are listed below.

- Work surface 30 inches from floor
- 29-inch clearance beneath the top to a depth of at least 20 inches and a minimum width of 36 inches to allow leg space for the seated individual
- Utility and equipment controls within easy reach
- Clear aisle width sufficient to maneuver a wheelchair (recommended width is 42 to 48 inches). If the aisles are too narrow, a lab station can be set up at the end of the bench, or a portable station can be designed or purchased.

If the student can transfer from the wheelchair, another alternative is to design a more maneuverable chair for use in the lab only. An adjustable-height wheelchair may include a tray that can be snapped onto the chair's arms to carry equipment such as flasks and crucibles, leaving both hands free to operate the chair.

The science laboratory can be more accessible to students with impaired mobility by making various modifications. First, work with the student to anticipate areas that may be difficult to access. Figure out alternative procedures, using as much student input as possible. Other modifications may include the following:

1. Adjust the height of storage units, or provide alternative storage space like a portable lazy Susan or cabinet on casters.

2. Provide work space for special equipment.

3. Supply counter tops for auxiliary use in science labs.

4. Lower shelves to lap-board height for holding instruments for students in wheelchairs.

5. Provide single-action level controls or blade-type handles rather than knobs.

6. Assign a lab partner who can help reach or manipulate objects as needed. Students whose disabilities affect the use of both upper and lower limbs may need a lab partner to perform experiments under the student's direction. The student should be able to observe the data acquisition and direct the experiment.

7. Modify built-in lab tables (or use small ramp/platforms or table-type desks) that can be adjusted for various heights of wheelchairs.

8. Provide an easy means for recording data, charts, or graphs.

9. Use electric hot plates instead of Bunsen burners as heat sources.

10. Use nonmanual types of laboratory teaching techniques (electronic probes vs pipette bulbs) for students with arm/hand impairments.

11. Have operating knobs and switches on laboratory hoods in easy access. The portable hoods meet safety standards and are accessible.

12. Have accessible water, gas, and electric facilities.

13. Increase the size of wheels, dials, handles, and buttons on lab equipment.

14. Change the aisle width by relocating desks and/or chairs as needed for wheelchair access.

15. Use lab sinks that are accessible from three sides for those who are single-side paralyzed.

16. Use low-force electric microswitches for lights and equipment.

17. Use wider/bigger lids on the tops of containers.

18. Have a portable eyewash available.

19. When information gathering involves a physical action that the student cannot perform, try using a different type of experience that will yield similar information.

20. Plan for class/lab times when a student with a mobility impairment may be late for class, if breaks between classes are short (10 minutes or less). This way, the student won't miss important aspects of the science activity.

21. Explore alternative ways for students who cannot fully use a computer because of physical limitations. Adaptations may include adaptive access software, altered keyboards (including Unicorn keyboards), special latching devices or keylock switchers, Power Pads, eye-controlled input systems, touch-screens with light talkers, trackballs, and footmice.

22. Be aware of and prevent overheating for students with poor heat regulation.

Field experience adaptations. Discuss and anticipate areas of difficulty with students who have a physical disability so you can work out alternate activities/experiences together for fieldwork or field trips. Many students using a wheelchair will probably need other travel arrangements because they often need to rely on attendants and ramp-adapted vans or power-lift vans for transportation to and from field activities.

In the field, provide assistance, but also provide positive reinforcement when the student shows the ability and willingness to do something unaided.

- Increase size of wheels, dials, handles, and buttons on field equipment.
- Use a peer-buddy system.
- Use wider/bigger lids on the tops of containers.

When information gathering involves a physical action that the physically impaired student cannot perform, try a different experience yielding the same information.

Make special advance arrangements with curators for field trips checking to ensure that facilities are accessible to students with disabilities. Ask questions such as the following:

- Are there nearby parking spaces reserved for persons with disabilities?
- Is there a ramp or a step-free entrance?
- Are there accessible restrooms?
- If the site is not on the ground floor, does the building have an elevator?
- Are water fountains and telephones low enough for a student in a wheelchair?

Arrange with curators of museums, science centers, etc., for alternate activities if it is not possible to have the student in a wheelchair do the activities. Ask if objects can be moved or positioned to provide the student with visual or tactile access. Discuss any needs, problems, or alternatives with the student.

Visual Disabilities

Definition

People with visual impairment have either low vision or blindness. If they have low vision, they use whatever visual perception they possess to access information. People with blindness are not able to gather information visually. Visual disabilities present at birth, unless they are the result of injury, are referred to as congenital disabilities. Visual impairment that occurs later in life as a result of an accident or injury in called adventitious (Ward, 1986).

Visual disabilities are classified based on two quantifiable parameters: visual acuity and range of peripheral vision. Visual acuity refers to the resolution capability and its variation with viewing distance. Range of peripheral vision refers to the angle within which vision is effective. Legally, people are considered blind if their visual acuity is 20/200 or less or if their range of peripheral vision is 20 degrees or less (Smith & Luckasson, 1995). In general, children are eligible for special services (resource or itinerant teacher) if their measured distance visual acuity is 20/70 or less in the better eye with corrective lenses.

Visual impairments may include an inability to see peripherally, high or low sensitivity to normal light, blind spots in the visual fields, color blindness or an inability to see contrast, or a combination of these problems. With some vision disorders, vision may fluctuate and be affected by fatigue, emotions, or lighting.

. Good science teaching involves the frequent use of manipulatives and the ability to use tactile sensory input in broadening the experience base of students with visual impairments. By including visually impaired students in handling equipment, conducting investigations, and collecting data, teachers are enabling them to draw from a variety of schemata in cognitive processing. This is especially important in the development of abilities to utilize higher order reasoning.

Special Devices Used by Students with Visual Disabilities

Regular classroom teachers need to be aware of vision-aiding devices and their proper operation when working with a student with visual impairment. This will often include consultation with the resource or itinerant teachers, the parents, specialists in orientation and mobility, and others involved in a student's education. Students must be taught to use all of their senses to determine and maintain an awareness of the structure of the environment and how to move safely, efficiently, and independently. The skills and devices will depend upon the individual student's concept development, personal attributes, and limitations.

Science teachers should help prepare the student's Individualized Education Program (IEP) because they know the type of equipment needed for active participation in science classes and labs. The cost of some specialized equipment may be too expensive for some schools or individuals; however, funds are available from some rehabilitation, state, or local education agencies when a device is mandated on a student's IEP.

Optical devices. Optical devices for the individual are usually prescribed by an eye specialist; however, special adaptations are often necessary for visually impaired students in the science laboratory. Glasses with special prescriptions, magnifiers, and small telescopes are common optical aids. In the science laboratory, the science teacher needs to communicate with the orientation and mobility (O&M) specialist for adaptations that will allow the student to be an active participant. For example, a microscope or specialized optical aids could help the student collect data when using equipment in experiments or in outdoor field activities. It is unlikely that the O&M specialist will have a sufficient science background to know when and where optical aids are necessary, which means close collaboration between the science teacher and the O&M specialist.

Nonoptical devices. Lamps, bookstands, large-type books, sun visors and other shields, acetate, page markers, and reading windows are important in reducing glare, visual discomfort, and postural fatigue for students with low vision. Adapted measurement tools and bold-line paper, including graph paper, are available to increase the student's level of participation.

Devices for enhancing tactile functioning. Braille, braillewriters, raised-line drawing boards, templates, braille and raised-marking measurement tools, and specialized markers that create raised lines or dots are tools especially designed for visually impaired students. The Cubarithm Slate and Crammer Abacus are specially designed devices to facilitate mathematical computation. The Mowat Sensor, Polaron, and Sensory 6 are other specialized devices that provide tactile or auditory feedback about obstacles in the environment. They can be handheld or worn around the head or neck.

Devices for enhancing auditory functioning. Advances in technology, along with discoveries that recordings are commercially feasible, have greatly increased the availability of both learning materials and leisure-reading materials for individuals with visual impairments. Cassette tape recorders with variable speed components allow individuals to adjust the recording to comfortable levels. Science teachers can often obtain materials such as beeper balls and adapted gym equipment for use in science investigations. There are also electronic and computer accessories that can utilize measuring devices with variable auditory output for doing science experiments and research projects.

Electronic devices. Talking calculators, computers, speech synthesizers, and adapted software are available from many sources. The design of access technology for individuals with visual impairments is an ongoing endeavor, and several hardware and software devices can give students access to the computer screen. A speech synthesizer allows the student to hear what is presented on a computer screen via a speaker or earphone. A display processor allows the student to control the size, contrast, and brightness of a computer screen. Refreshable braille displays provide a small tactile braille version of what is on the screen. Braille embossers are special printers that produce materials in braille.

The American Printing House for the Blind maintains an educational research and development program that is concerned with educational procedures and methods and the development of education aids. The American Foundation for the Blind maintains six regional centers across the country and operates a toll-free information hotline.

Teaching Science to Students with Impaired Vision

Many students with severe visual disabilities have mastered science laboratory work. Blind students who have been accommodated in the laboratory testify that the work is not only educational, but enjoyable; for them, the hands-on experience was vital. Some students with impaired vision have completed laboratory sessions, possibly using only a magnifying glass or relying informally on a partner or nearby classmate to read numbers or confirm observations. Other students with impaired vision require more help. The degree of disability determines the policy to be adopted. Computer-interfaced devices are one way to provide an intermediate level of accommodation that allows blind students to work in the laboratory more independently.

Some students who are visually impaired may require a full-time laboratory assistant. In schools that allow or use the lab partner system, the instructor should help the student find a suitable partner. The assistant should not be taking the course simultaneously, but it is useful to have someone who has completed the class previously and knows the equipment and terminology. The science student does the thinking and directs the assistant to give a response. It is helpful for the student to have the opportunity before or during the lab session to feel and visualize how the equipment is set up. The student should be encouraged to be as independent as possible. In some cases, it may be necessary for the assistant to manipulate the equipment. The instructor should confirm that the assistant functions properly. When questions arise, the student with visual impairment should take them up directly with the instructor, not through the assistant, and vice versa.

Blind students negotiate best in familiar surroundings. Even though they may never need to visit remote parts of the laboratory, they should familiarize themselves with the entire setting. A short lab tour with the lab instructor locating sinks, reagent shelves, hoods, safety showers, and other equipment will orient the student and help to determine the best place to work. The student needs to find the exits, learn the bench configurations, memorize the positions of the utilities, and so forth. In this way, the laboratory becomes familiar and comfortable. This orientation session can also be used to explain the safety rules and outline fire drill and other procedures and it is the time to explain what locations in the laboratory pose the greatest potential hazards.

Blind students who have guide dogs may decide not to take the dogs into the laboratory. A small office nearby or an out-of-the-way spot at the far end of the balance room might be an ideal place to leave a dog. Guide dogs are obedient and accustomed to waiting.

Students with partially impaired vision may require no special laboratory assistance at all. However, one lab station may be better than another because the lighting is better. Some students with partial sight may need larger letters on reagent bottles, a magnifying glass to read burettes, or a larger notebook than prescribed for the course. Such requirements can often be met utilizing input from the student. The development of special equipment to facilitate laboratory work for students with impaired vision is a relatively new area of research, but progress is being made rapidly.

Classroom Suggestions Concerning Visual Impairments

1. Get to know each student and be sensitive to his or her feelings and wishes. It is generally best to be open and honest about visual disabilities. Other students usually adjust well when they understand the visual limitations of a peer. However, particularly early on, if the student wishes, sensitivity and discretion should be practiced. Introduce the student with a visual disability as you would any other student. Encourage the student to answer questions from adults and other students in a direct and straightforward manner.

2. Apply the same general rules in regard to praise and discipline. However, because visual expression is a very common form of praise, special efforts should be directed to give verbal encouragement or a pat on the shoulder.

3. Look at traffic patterns and access to materials in the classroom and laboratory. Provide additional work, desk, aisle, and locker space to accommodate movement and special materials.

4. If students have adaptive devices, be sure they are using them and that the devices are working properly. Watch for apathetic and dependent behaviors, and work with the students to ensure that they are engaged whenever possible.

5. If the student exhibits certain mannerisms that affect peer relationships and interfere with learning in the classroom, work with the student and itinerant teacher in dealing with this behavior.

6. Model acceptance, provide encouragement, and maintain high expectations. Workload and time expectations should approximate those of other students in the class.

7. Use tactile stimuli, provide printed directions in large print or braille, adjust light levels, and provide auditory directions with appropriate pacing.

8. Work closely with the resource teacher, itinerant teacher, and orientation and mobility specialist to design lessons that will enable the visually impaired student to be active in all activities.

9. Don't hesitate to use peer helpers and plan lessons using cooperative learning strategies.

10. Encourage independence, and seek out ways the student can reciprocate assistance to others.

Managing Instructional Activities for Students with Visual Impairment

Common areas in which accommodations may be needed, as well as strategies for dealing with each, are presented below.

Deficit: The student requires accommodation for printed class materials.
Strategies:

- Lend any transparencies, notes, and print materials to the resource or itinerant teacher to enlarge, darken, or braille them.
- If the student has low vision, work with the student for the best seating placement for visual comfort. If the student is using a prescribed telescopic device, be sensitive to placement and time considerations.
- Assign a classmate to make photocopies of notes and diagrams.
- Speak the notes or transparency text aloud and allow sufficient time for the student to take notes.
- Investigate ways to use an adapted laptop or portable computer.
- Use recordings with earphones when appropriate. Compressed speech devices are also available that will enable the student to progress through the text at a rate approximating silent reading.

Deficit: The student requires accommodation for information presented through visual aids.
Strategies:

- When using maps and charts, raised maps or "sound maps" may be used.
- Get charts and maps to the resource or itinerant teacher in advance. It may be possible to enlarge, modify, or simplify the materials so the student can use them.
- Make arrangements with the resource, itinerant teacher, or aide to show a videotape or film to the student in advance or after class to aid the student in learning the visual concepts presented. Make advance arrangements for descriptive video enhancement for multimedia materials used in the classroom.
- Investigate other resources on the same concepts that can allow alternative ways to learn the material.

Deficit: The student requires accommodation for classroom demonstrations.
Strategies:

- Examine the demonstration area to provide maximum visual comfort by reducing glare, using large models, and conducting the demonstration in a location with maximum contrast (e.g. a dark background).
- Allow the student to handle the materials before and/or after the demonstration period. Have the student assist in the demonstration (as an accommodation to the visual limitation rather than as a special privilege) whenever it is reasonable.
- Consider videotaping the demonstration or closed circuit television to provide a means of magnification and/or subsequent review.
- Investigate the availability of audiotaped descriptions of demonstrations and visual presentations.

Deficit: The student requires accommodation in evaluation and testing.
Strategies:

- It is normal for a student with a visual impairment to require additional time to complete tests. Time and a half is a good general rule of thumb. Do not overuse oral testing when there are other options. Visually impaired students need to maintain print and braille literacy. Often a tape recorder with earphones along with a portable computer will allow the student to take tests independently.
- For low vision students, enlarging the text on a copy machine may help. A yellow acetate filter is often helpful to the student to provide better contrast when reading.
- Work closely with the resource and itinerant teacher to plan evaluation strategies. When visually impaired students develop adaptive skills, your expectations should approximate those for other students. It is important to instill confidence in their competence.

Deficit: The student requires accommodation in homework.
Strategies:

- When thinking about work outside of class, think in terms of time rather than common assignments. It is unfair to take away an individual's childhood or free time in order to meet the same homework expectations of others who can work more quickly.
- Consider allowances for extra time to repeat laboratory exercises outside of the school day and to review lessons using visual and print materials in class.
- Work with the itinerant or resource teacher on advanced concepts. Many times these individuals have very limited science backgrounds, particularly at higher levels.
- Set aside time for yourself to work with the student outside of class to help with difficult concepts or unfamiliar vocabulary. In class, use cooperative learning and peer assistance when appropriate.

Deficit: The student requires special accommodations for laboratory and field trip activities.
Strategies:

- Make the work area accessible for the student. Work with the M&O specialist and the resource teacher to help the student become familiar with the instructional materials and laboratory equipment. Investigate equipment adaptations that can be made locally, and place supplies so they are accessible to the student.
- Contact the American Council for the Blind and the American Foundation for the Blind to obtain information about special devices, laboratory equipment, and appliances for individuals with visual impairments. Seek out suppliers of specialized equipment, and examine resources with the student and other specialists.

- Establish a buddy system in which the visually impaired student can work cooperatively with a seeing peer to conduct investigations.
- Make the laboratory accessible before and after class sessions devoted to experiments. A visually impaired student will need some advanced exposure to the materials and the procedures. Normally they will need extra time to carry out the investigations and additional time in the laboratory to review their results.
- Think through your directions and plan out your verbal instructions to ensure they are complete; get print materials to the resource teacher prior to the activity.
- Keep in mind the principle of partial participation when it is impossible to have full involvement because of safety or mobility factors. If the student cannot actually collect samples, plan out strategies to get the materials to the student.

Laboratory Modifications

- Describe and tactually/spatially familiarize the student with the lab and all equipment to be used.
- Use an enlarged activity script, directions, or readings for a low-vision student (or taped script for a student who is blind) for use with tactile 3D models.
- Make all handouts and assignments in the appropriate form for the students: e.g., regular print, large print, braille, or tape depending on the student's optimal mode of communication.
- Provide assistance when needed for converting certain laboratory materials from a visual to a tactile format.
- Have the student with a vision impairment do a trial run on the equipment before the activity.
- Allow more time for the laboratory activities.
- Always try to keep materials, supplies, and equipment in the same places.
- Use a microprojector or similar device to help the visually impaired student examine images from a microscope.
- Place the student and/or tape recorder an appropriate distance from the activity to permit hearing and/or the recording of results or observations.
- Use an overhead projector or opaque projector to show step-by-step instructions. Mask all the instructions except the one(s) that you want followed for students with vision impairments.
- Use Descriptive Video for videos or laser disks. If Descriptive Video is not available, use a sighted narrator to describe movies, videos, laser disks, or slides.
- Provide means for the acquisition and/or recording of data in an appropriate mode for the student.
- Use tag shapes for showing relationships (such as distance comparisons), buttons, or other markers on a "layout" board.
- Use braille label maker for identifying materials and containers in the laboratory for students with a vision impairment who read braille.
- Provide accessible equipment that the student with a vision impairment can use to interpret and understand the results of laboratory exercises (e.g., audible readout voltmeters, calculators, talking thermometers, talking compass, magnifiers, etc.).
- Use a hot plate for heating instead of Bunsen burner.
- Label material, supplies, and equipment with regular print, large print, and/or braille, as appropriate for the vision-impaired student.
- Pair the student with a vision impairment with a sighted student. Then have the non-impaired student describe the activities and outcomes as they are observed.
- Use a low-vision projection screen to magnify images up to 720X.

- Use a portable communication board to provide auditory scanning of laboratory materials such as pictographic symbols, letters, and/or words.
- When using a computer, have the student with a visual disability use a voice input device or a remote voice system to verbally enter commands.
- Prior to the enrollment of a student with a visual impairment in class, obtain laboratory equipment that has available ability to produce adaptive outputs such as a large screen, print materials, or various audio output devices.
- Use various braille devices to assist vision-impaired students when reading.
- Consider alternate activities/exercises that can be utilized with less difficulty for the student, but have the same or similar learning objectives.

References to such equipment can be located easily on the Internet or through science organizations such as AAAS or NSTA. Examples of equipment now available include:

- Voltmeters and multimeters with audible readout
- Talking thermometer
- Light probes (used as part of readout devices; it emits a tone that increases in pitch proportionally to changes in light intensity)
- Liquid-level indicators
- pH meter
- Talking balance
- Spectroscope
- Electronic calculators with braille printout
- Braille labelers
- Braille rulers and meter sticks
- Braille thermometer
- Laboratory glassware with raised numbers
- Sandpaper labeling for hazardous chemicals
- Spoons with sliding covers
- Electronic calculators with both voice and braille output
- Microcomputers equipped with interfacing cards to control a variety of instruments

Field Experience Adaptations

- Make all handouts, safety information, and assignments available in an appropriate form (e.g., regular print, large print, tactile Braille, or cassette).
- Use a sighted guide.
- Do detailed description and narration of objects seen in science centers, museums, and/or field activities.
- Provide a laser cane or mowat sensor to assist the student in unfamiliar surroundings.
- Use an enlarged activity script, directions, or readings for descriptions of a field/activity for a low vision student.
- Suggest that the student use a standard tape recorder.
- Consider alternate activities/exercises that can be utilized with less difficulty for the student, but have the same or similar learning objectives.

Deaf and Hard of Hearing

Definition

Persons with hearing impairments fall into two main categories--those who are hard of hearing and those who are deaf. Individuals who are hard of hearing still have some degree of hearing, which may or may not be enough for them to use auditory information in communication. Deaf persons have no ability to hear. Hard-of-hearing conditions are sometimes labeled as a mild or moderate disability, while the terms severe or profound disability describe the condition of deafness. About .12% of students are identified as hearing impaired.

Hearing impairments are often labeled as one of the "invisible disabilities" because the disability is not apparent by visual observation. However, deafness is in many cases a more severe disability than being blind. In addition to severe problems with language development and academic achievement, a hearing impairment often affects a student's social and personality characteristics. Given the severe communication problems students with hearing impairment have, they often seek out friends with the same disability.

Hearing disability is affected both by the level of hearing impairment and the time of onset of the disability. Individuals who are born deaf or acquire deafness before developing language usually have much more difficulty acquiring spoken language and performing academically. Because communication is so dependent upon auditory stimulation, hearing-impaired students lack inferential stimulation from the onset of the disability. Much of our developmental reasoning is nurtured through sounds we hear, from hearing a door close to making judgments about people on the basis of how they interact orally. In addition, many individuals may have hearing impairments due to cognitive processing difficulties or a limited range of hearing (e.g., an inability to receive or process the frequency range of normal hearing).

As with other disability areas, positive social adjustment has much to do with how others accept the disability. A teacher who models a cheerful, positive, accepting individual with high expectations can greatly influence the socialization of the student with a hearing impairment. The classroom teacher must reflect confidence in the competence of the student in all aspects of performance: physically, academically, emotionally, and socially.

Today about two thirds of hearing-impaired students are taught by total communication, in which the use of sign language is paired with oral techniques. About one third are taught by oral techniques and learn speech reading and how to effectively use the hearing they do possess. With patience and careful listening, they can understand the majority of the students who are not deaf. Hearing-impaired students who have received the benefits of excellent instruction, particularly those with strong and stable support from home, may exhibit good language and academic skills.

General Accommodations for Students who are Deaf or Hard of Hearing

- Locate student in the classroom seating for direct eye and lip visibility.
- Secure student eye contact before speaking.
- Keep your face and lips visible to the deaf student when speaking.
- Slow your speech and speak clearly.
- Repeat responses of other students, or delay individual responses until the student has good eye contact with the speaker.
- Pre-teach vocabulary and allow student to explore the materials prior to the lesson.
- Provide a supportive peer assistant to assist during the activities.
- Allow extra time for student and peers to engage in activities of choice outside of school day and at home.
- Prepare printed directions in advance and laminate a copy so the direction sheets last longer.

- Have interpreter accessible if desired.
- Review directions with the student.
- Review lighting and background for appropriateness.
- Communicate with the student concerning any interference from background noises.
- Search out adaptive equipment and supplies and make them available to the student (i.e., probe-ware, oscilliscopes, etc.)
- Maximize availability of visual media and/or models.
- Allow for direct manipulation of material when appropriate.
- Clearly label items or equipment.
- Get feedback from student.
- Allow more time.
- Use a handling device "microphone" to be used by any student who speaks during cooperative group activities.

Classroom Suggestions

1. Get to know the student and be sensitive to the student's feelings and wishes. It is generally best to be open and honest about the hearing disability and adaptations necessary for communication. Other students usually adjust well when they understand the hearing limitations of a peer. However, because speaking is such a continuous process, it may be necessary to remind classmates to interact in ways that include everyone. Particularly early on, be sensitive and discreet if the student wishes. Introduce the student with a hearing disability as you would any other student. Encourage the student to answer questions from adults and other students in a direct and straightforward manner.

2. Work with the student on seating location, background, appropriate ways to get attention (e.g., tapping on the shoulder), visual accessibility to other students, and alternative modes of communication if there is limited language development.

3. If the student uses an interpreter, work on an arrangement in which the student can see both you and the interpreter.

4. Arrange for a notetaker. A student cannot speechread or use an interpreter while taking notes or watching a demonstration.

5. Draw the student's attention before speaking, face the student when you speak, and keep your face visible and well-lit. Speak clearly and naturally.

6. Provide instruction to classmates to model the same behaviors (i.e., face the hearing-impaired student when speaking, keep your head up, keep your hands from your face, speak clearly and naturally with good lip movement). When appropriate, repeat the questions and comments of others in the room. If possible, seat students in a circle or partial circle to enhance visibility. Require that students have a device in hand (i.e. paper towel end roll) before speaking when doing discussions or group work.

7. Apply the same general rules in regard to praise and discipline. However, because oral expression is a very common form of praise, special efforts should be directed to give visual encouragement.

8. Watch for apathetic and dependent behaviors and observe students to ensure that they are

engaged. Be sensitive to fatigue. Students with a hearing impairment must rely on visual input and must process the information. This is often very exhausting, and breaks must be built into the schedule so they can rest.

9. If the student has adaptive hearing devices, be sure the student is using them and that they are working properly.

10. If the student exhibits certain mannerisms that affect peer relationships and interfere with learning in the classroom, work with the student and itinerant teacher in dealing with this behavior. Assisting in student socialization is an important part of your teaching responsibilities.

11. Model acceptance, provide encouragement, and maintain high expectations. Check for comprehension often. Workload and time expectations should approximate those of other students in the class.

12. Use visual and tactile stimuli. Provide printed material for directions, assignments, and test schedules. Provide auditory directions with appropriate pacing. Use an overhead and visual aids as much as possible.

13. Whenever possible, use captioned films or videos. Investigate the availability of real-time captioning devices or assistive listening devices.

14. Work closely with the resource teacher to preview new concepts. Vocabulary in science is particularly difficult because hearing-impaired students lack the experiences and exposure to many science concepts that have been repeated and reinforced for hearing students.

Laboratory Modifications

Students who are deaf or hard of hearing require few specific physical accommodations in the science laboratory. However, there are important laboratory safety considerations: (a) Use electrical devices or power strips with visual indicators, (b) install visual or sensory alarms, and (c) install an accessible telephone with a telecommunication device for the deaf (TDD). The following are suggestions for maximizing the effectiveness of laboratory experiences for hearing-impaired students.

- Plan lessons using cooperative learning strategies. Encourage student interdependence, and look for ways the student can reciprocate assistance to others. Be sensitive to selecting laboratory partners who will be patient and responsive in communication.
- Avoid seating the student in heavy traffic areas.
- As you demonstrate a procedure or technique, deliberately alternate between speaking (use FM audio trainer for hard of hearing) and manipulating the materials. This allows the student who is hearing impaired to look at one thing at a time.
- If the student does not understand, try repeating; if the student still does not understand, rephrase a thought or use a different word order. Be patient; the interpreter may not have science knowledge. You may need to demonstrate or display apparatus.
- Keep visual pollution on the chalkboard to a minimum. Leave only what you are discussing.
- Write new vocabulary words on the chalkboard before the laboratory experience.
- Make chalkboard notes legible.

- Do not talk while writing on chalkboard.
- Maximize the use of visual media and demonstrations.
- Repeat new vocabulary in different contexts for reinforcement.
- Assign students with hearing impairments to a laboratory station that allows an unobstructed view of the chalkboard and the instructor and/or interpreter.
- Begin explanations with concrete examples, working from the concrete to the abstract.
- Write on the board or on paper any changes in experimental procedures, assignments, exams, due dates, or special events.
- Label equipment and materials to aid in the learning of new vocabulary items.
- Provide concise, step-by-step directions prior to the laboratory activity and preview it with the student, if possible.
- Provide indicator lights for the on/off status of equipment.
- Obtain feedback from your hearing-impaired students at every opportunity as an indicator of the level of understanding.
- Use <u>signaling devices</u> to alert the student to a significant sound in the lab.
- Use an <u>overhead projector</u> to show step-by-step instructions. Mask all the instructions except the one that you want followed next.
- Provide an outline of the lesson/activity/handout to the student in advance, and give your expectations.
- Present only one source of visual information at a time.
- If noncaptioned videos or movies are shown, a dim light is needed so that the student who uses an interpreter can see the interpreter’s signing.
- Provide or adapt reading materials at appropriate reading levels and provide resource material at these same reading levels.
- Use highly visual materials (e.g., many figures, pictures, diagrams) in reading assignments.
- Consider alternate activities/exercises that can be utilized with less difficulty for the student, but have the same or similar learning objectives.

Field Experience Adaptations

- Adapt as many activities as possible to a visual mode.
- Consider alternate activities/exercises that can be utilized with less difficulty for the student, but have the same or similar learning objectives.
- Whenever possible, allow for direct access to and manipulation of materials.
- Use flash cards for clarity in field exercises.
- Use an interpreter.
- Use a “buddy system”–be sure the buddy is alert and sensitive to any dangers relating to auditory stimuli.

Learning Disabilities

Definition

Persons described as learning disabled can suffer from one or more of a number of diverse conditions. Cartwright, Cartwright, and Ward (1995) have offered examples including brain injuries, deficiencies in attending behaviors, dyslexia, discalculia, and a host of others. These authors report that, as with some other disability categories set out in the IDEA, the definition of learning disability varies between states and between researchers and remains contentious. Common to most definitions of learning disabilities is the idea of a significantly diminished ability to communicate with and understand language in spoken and written forms (Vaughn, Bos,

& Schumm, 1997). The disorder is intrinsic to the individual, presumed to be due to a central nervous system dysfunction, and may occur across the life span (National Joint Committee on Learning Disabilities, letter to NJCLD member organization, 1988, p.1). Students with learning disabilities tend to interact with both teacher and other students at a lower rate than their peers. The inability to understand and perform mathematical calculations, speak, write, and read are included in this learning difficulty.

Classroom Accommodations

The learning disabled student often has a number of limitations that require accommodations in learning materials, time, support, strategies, and methods. Good science is by its nature rigorous, and the trauma for learning disabled students of repeated failure often results in uncontrollable withdrawal. Learning disabled students often come to believe that their fate is unrelated to their behavior. Even when science is subsequently placed in a situation where their responses might be instrumental in providing a successful learning experience, they nevertheless cannot perceive the possibility of gaining control due to their past history (Gentile & Monaco, 1988). This ensuing lack of educational preparation results in dumping able individuals with learning disabilities into a world where they cannot be successful in science classes and into occupations not commensurate with their talents, abilities, or interests.

In a majority of situations, the reactions teachers get from a student with learning disabilities is a result of alienation that occurred during the student's beginning school experiences. One type of learning disabled student in science is described as a dropout who is not identified because the student keeps coming to class. However, the student's presence is only physical, and it seems that it is impossible to motivate or engage the student into actively participating in the learning process. Our challenge as educators is not only to improve teaching, but to put into place mechanisms that elicit participation and responsibility on the part of all students.

Clear expectations are critical, beginning with the teacher's first contact with students with learning disabilities. Students need to know the structures that define behavior in the classroom, and they must develop a sense of acceptance and belonging.

Students with learning disabilities often need to have a very specific understanding of what they should be doing. If expectations are vague, it is only natural that they will test the limits to find where the boundaries are. If limits are undefined or variable, the teacher can expect to be tested throughout the year. Wright (1993), in a study of effective teacher practices with inclusion, found practiced routines and relatively fixed schedules were manifested through modeling and teacher action.

Unconditional acceptance, including the right of every individual to be treated with dignity and respect, is an essential area of imprinting. On the first day of school students must be told, "You are going to be successful in this class. I will make accommodations to help you succeed. I am willing to get to know you as a person. I will provide appropriate opportunities for you, but to learn, you must accept responsibilities. We must be able to communicate in order to determine an appropriate program. Trust me."

These are easy words to say, but to establish credibility, actions must consistently support this position. Trust takes time, and the effective teacher must be willing to devote the personal time in order to establish a sense of trust and confidence from the students. Students with learning disabilities often feel out of place and often must deal with severe learning problems on their own outside of the classroom. These problems can often be overwhelming for a student, leaving little energy and desire to focus on the rigorous tasks associated with school.

The following are general accommodations that can assist the learning disabled student to stay focused and on task.

- Eliminate distractions.
- Review directions in advance.
- Give undivided attention to the student
- Allow for signaled response.
- Don't pretend to understand if you do not.
- Focus on what is said, not how well it is said.
- Listen patiently.
- Allow more time.
- Review lighting and background for appropriateness.
- Eliminate background noises.
- Maximize availability of visual media and/or models.
- Clearly label items or equipment.
- Allow for direct manipulation of material when appropriate.
- Get feedback from student.
- Provide a reader when appropriate.
- For students with perceptual problems, avoid computer answer sheets.
- Allow alternative response modes (e.g. circles or dictation)
- Consider pacing.

Laboratory and Field Experience Modifications

The modifications below deal with specific ways that laboratory and field experiences can be improved for learning-disabled students.

- Clearly label equipment, tools, and materials. Color-code them for enhanced visual recognition.
- Provide clear photocopies of your notes and overhead transparencies.
- Make cue cards or labels that tell the steps of a procedure to expedite student understanding.
- Use an overhead projector with an outline of the lesson or unit of the day.
- Plan for extended work time in the laboratory.
- Allow extended time for responses and the preparation and delivery of reports.
- In dealing with abstract concepts, use visual tools such as charts and graphs. Also, paraphrase and present them in specific terms, and sequence and illustrate them with concrete examples, personal experiences, or hands-on exercises.
- To minimize student anxiety, provide an individual orientation to the laboratory and equipment, and give extra practice with tasks and equipment.
- Find areas of strength in the student’s lab experiences, and emphasize those as much as possible.
- Allow students with learning disabilities the use of computers and spell-checking programs on assignments. Consider alternate activities/exercises that can be utilized with less difficulty for the student, but have the same or similar learning objectives.

Attention Deficit Hyperactivity Disorder

Definition

Attention deficit hyperactivity disorder (ADHD) is one of the most controversial categories of disabilities included in the IDEA. There is difficulty in definition, diagnosis, and treatment. Smith (1998) reports that from 10 to 20% of school-age children have some type of learning disability that can be related to an attention deficit problem. Other authors reported that smaller numbers of children can actually be diagnosed as suffering from the defined disability ADHD (Vaughn, et al., 1997).

Many authors agree that among the key ingredients in diagnosing ADHD are heightened levels of inattention, characterized by a failure to correct mistakes of a casual nature; avoiding tasks that require concentration; and a susceptibility to distractions of various types. Additional requirements for diagnosis include hyperactive behaviors such as a propensity for fidgeting, difficulty in quiet play and activities, and excessive talking. Impulsivity is also common in many definitions and is usually described in terms of typically impulsive behaviors such as blurting out answers in class and interruptions in games or conversations. Barkly (1990) has said that the affliction affects males in a rate of 6:1 in diagnosed cases and has indicated as many as 33% of males could be diagnosed as ADHD (p. 66).

Classroom accommodations for student with ADHD are similar to those for students with learning disabilities.

Classroom Accommodations

- Eliminate distractions.
- Review medications and the effect on the student; consider this in planning any testing schedule.
- Be straightforward.
- Allow for time-out if a student needs it.
- Review directions in advance.
- Give undivided attention to the student.
- Allow for signaled response.
- Don't pretend to understand if you do not.
- Focus on what is said, not how well it is said.
- Listen patiently.
- Allow more time.
- Review lighting and background for appropriateness.
- Eliminate background noises.
- Maximize availability of visual media and/or models.
- Clearly label items or equipment.
- Allow for direct manipulation of material when appropriate.
- Get feedback from student.
- Provide a reader when appropriate.
- For students with perceptual problems, avoid computer answer sheets .
- Allow alternative response modes (e.g. circles or dictation). Consider pacing.

Laboratory and Field Experience Modifications

- Establish and maintain consistent routines and consistent expectations.

- Gradually reduce the amount of assistance, but keep in mind that these students will need more help for a longer period of time than the student without a disability.
- Use a daily assignment notebook as necessary, and make sure each student correctly writes down all assignments. If a student is not capable of this, provide assistance.
- When appropriate, provide a list of printed instructions in a sequential format. Keep instructions as simple and straightforward as possible.
- ADHD students may need both verbal and visual directions. You can do this by providing a visual model and a verbal description of what the student should be doing.
- You can give an ADHD student confidence by starting each lab assignment with a few questions or activities you know the student can successfully accomplish.
- To help with changes in assignments, provide clear and consistent transitions between activities and notify the student with ADHD a few minutes before changing activities.
- Make sure all students comprehend the instructions before beginning their tasks (the ADHD student will probably need extra assistance).
- Simplify complex directions. Avoid multiple commands.
- Help the students feel comfortable with seeking assistance (most students with ADHD will not ask for help).

Developmental Delays

Definition

Developmental disability, also referred to as mental retardation, includes a wide distribution of impairments, which hampers a precise definition. Cartwright, et al. (1995) report that in a review of such definitions published in 1978, over 30 distinct definitions were found. One of the difficulties associated with the imprecise definition results from the fact that it is extremely rare to find an individual with developmental disabilities who exhibits all of the descriptors in the definitions (Wood, 1998). Another variable used in the definition of developmental disability is the IQ score. A popular cutoff point is a score of less than about 70 to 75. Below this level, persons are often labeled as mentally retarded or developmentally delayed (Bullock, 1992). Bullock and Smith (1998) have both presented statistics that conclude that this cutoff indicated that 1 to 3% of the population is included under this definition of developmental disability.

Special education teachers utilize a number of adaptive information-processing and mnemonic techniques (Mastropieri & Scruggs, 1994), adaptive instructional strategies (Woodward, 1994), and adaptive strategies for textbook modification (Lovitt & Horton, 1994). The majority of these are unfamiliar to science teachers. It is also unlikely that general classroom teachers will employ these strategies without regular collaboration.

Exercises in textbook modification and lesson adjustment are important adaptations for students with developmental delays.

The following are suggestions for modifying materials cited by Lovitt and Horton (1994, p. 115):

1. Modify only textbook chapters or passages within chapters that have proven difficult for students or that clearly lack organization.

2. Collaborate and work as a team to modify a textbook chapter. This can simulate how a teacher can work with other teachers to reduce the overall workload associated with adaptive instruction by dividing the modification load and sharing materials.

3. As part of associated field experiences, use curriculum-based assessments prior to instruction to determine which students can interact with the text at an independent level and which students will need material modified.

4. Examine science textbook series and review the total program. Look at study guides, graphic organizers, vocabulary exercises, computer programs, or other adaptations of material in addition to basic textbooks and supplementary materials.

Other classroom modifications for students with a developmental disability could include the following:

- Meet with the student and/or aide to discuss accommodations in private prior to each learning sequence.
- Pre-teach laboratory whenever possible.
- Review directions in advance.
- Provide a reader if necessary.
- Examine vocabulary in advance and consider options.
- Review lighting and background for appropriateness.
- Eliminate background noises.
- Maximize availability of visual media and/or models.
- Allow for direct manipulation of material when appropriate.
- Get feedback from student.
- Allow more time.

Behavioral Disorders

Definition

Smith (1998) implies that behavioral disorders, like ADHD, are very problematic to define. One of the aspects of behavioral disorders that makes their definition difficult is the fact that nonbehavior-disordered children often exhibit inappropriate behavior and that children who have been officially diagnosed as behavior-disordered often behave in quite reasonable, normal ways (Cartwright, et al., 1995).

Schemes for categorizing the actions of students with behavioral disorders usually define two main types of aberrant behavior: externalizing behaviors and internalizing behaviors. Externalizing might be most readily understood in terms of behaviors such as hostility toward other students and toward instructors, physical aggression against other persons, and obscene gestures. The second main category, internalizing behavior, is typified by such affects as excessive shyness and more extreme forms of behavior such as anorexia and bulimia (Smith, 1998).

Classroom Accommodations

Many of the following adaptations have been presented previously for students with ADHD and for those with learning disabilities.

- Discuss appropriate accommodations privately in advance.

- Provide a cooperatively determined "time-out location" where the student can go to after a signaled response from the teacher.
- Review directions in advance.
- Give undivided attention to the student.
- Allow for signaled response.
- Don't pretend to understand if you do not. Focus on what is said, not how well it is said.
- Allow for computer or written response.
- Listen patiently.
- Allow more time.
- Don't confront a confrontational child in public if possible to avoid.
- Whenever possible, allow a "cooling off" alternative.

Laboratory and Field Experience Modifications

- Establish and maintain consistent routines and consistent expectations.
- If unstructured activities must occur, clearly distinguish them from structured activities in terms of time, place, and expectations.
- Be sensitive when making team pairings for activities so that the student with an emotional disorder is supported.
- Use a wide variety of instructional equipment that can be displayed for the students to look at and handle.
- When an interest in a particular piece of equipment has been kindled, talk to the student about it and show him or her how to use it.
- Make activity instructions should be simple but structured.
- Monitor carefully to ensure that students without disabilities do not dominate the activity or detract in any way from the successful performance of the student with a behavioral disorder.
- Make special efforts to get students with behavioral disorders to interact in laboratory activities.
- If a student must be denied permission to use the equipment, do so on an impersonal basis so the student will not feel hurt or discriminated against.
- Plan for successful participation in the laboratory activities by students with behavioral disorders. Success is extremely important to them.
- To ensure success, consider the special needs and interests of each person; give friendly, patient instruction in the laboratory skills; and continually encourage a wider interest in activities.
- When a student displays a reaction of dislike to the activities, allow a time-out option. Address the problem privately with the student. Avoiding an activity often stems from fear of the experience or factors inherent within the situation itself.
- Keep in mind that some students with behavioral disorders may go to great lengths to avoid class participation. Feigning their disorder is the method most frequently used, in hope of being excused from participation.
- Consider alternate activities/exercises that are less difficult for the student, but have the same or similar learning objectives.

Speech and Language Disabilities

Definition

Communication is basic to our lives; without it we do not fare well either psychologically or academically. Vaughn, et al. (1997) state that communication is necessary for the proper development of social relationships of all kinds and for the most basic of our actions, such as expressing our personal needs and desires. These authors have reported that approximately 7 to 10% of school-age children have some type of speech and/or language disorder, including mild disabilities, that affects their communication, while 2 to 3% of students with disabilities have speech and/or language difficulties as their primary disabling condition.

A language disorder is an impairment in the ability to understand and/or use words in context, both verbally and nonverbally. Some characteristics of language disorders include improper use of words and their meanings, inability to express ideas, inappropriate grammatical patterns, and reduced vocabulary and inability to express ideas or to follow directions. One or a combination of these characteristics may occur in children affected by language learning disabilities or developmental language delay. Children may hear or see a word but not be able to understand its meaning. They may have trouble getting others to understand what they are trying to communicate.

Speech disorders refer to difficulties producing speech sounds or problems with voice quality. They might be characterized by an interruption in the flow or rhythm of speech, such as stuttering, which is called dysfluency. Speech disorders may be problems with the way sounds are formed, called articulation or phonological disorders, or they may be difficulties with the pitch, volume, or quality of the voice. There may be a combination of several problems. People with speech disorders have trouble using some speech sounds. Listeners may have trouble understanding what someone with a speech disorder is trying to say. People with voice disorders may have trouble with the way their voices sound.

Classroom Accommodations

- Work with the speech language pathologist in cooperation with the student to discuss appropriate strategies.
- Allow the student to meet in private before or after school relating to assignments.
- Discuss appropriate teaching interventions with the student in advance.
- Use computers with visual output.
- Use electronic mail.
- Investigate speech synthesis options.
- Consider Internet-accessible services/resources as alternative learning options.
- Review directions in advance.
- Give undivided attention to the student.
- Allow for signaled response.
- Don't pretend to understand if you do not.
- Focus on what is said, not how well it is said.
- Allow for computer or written response.
- Listen patiently.
- Allow more time.

Laboratory Adaptations

- When possible, allow the student to use a technical output device (e.g., laptop computer).
- Be a good listener.
- Preplan for accepting laboratory partners.
- Allow more time for the student to complete activities.

- Anticipate areas of difficulty in access and involve the student in doing the same. Together, work out alternate procedures while trying not to disengage the student from the activity.
- Place the student within a reasonable distance from the instructor, so the instructor can meet his or her needs.
- If appropriate, provide assistance, but also provide support when the student shows the ability to do things unaided.
- Consider alternate activities/exercises with less difficulty for the student, but with the same or similar learning objectives.

Field Experience Modifications

- Discuss with students any needs, problems, or alternatives they anticipate in the field learning environment.
- Make special advance arrangements with curators during field trips to museums, etc.
- When information gathering involves a communication action that the impaired student cannot perform, try a different experience yielding the same information.
- In the field, provide assistance, but also provide support when the student shows the ability to do something unaided.

Autism

Definition

Autism is the largest growing and perhaps the least understood disability category. It is the fastest growing developmental disability with a 10-17% annual growth. The abnormality is reflected in 1 in 166 births and affects 1 to 1.5 million Americans (Autism Society of America, 2006). 1As recognized under the IDEA, diagnosis includes the demonstration of a persistent pattern of isolation that begins before the age of 3 years. This early onset of social and other difficulties is a main feature of the disorder diagnosis.). The most prevalent symptoms are difficulty communicating and forming social relationships. Another common manifestation is the presence of self-stimulatory behaviors such as rocking the body or repetitive manipulation of objects. Persons may exhibit a wide variety of inappropriate behaviors ranging from tactile defensiveness, a reluctance to engage in exploration, to hyperactivity and, possibly, self-injury. In addition to non-communicative behaviors with others, many persons with autism engage in abnormal behaviors with respect to objects. Many times these behaviors seem to relate to fixations.

Classroom Accommodations

- Provide an area and opportunity for quiet.
- Establish a walking area to allow physical release in a quiet and safe place.
- Provide consistent structure and organization.
- Label areas for specific activities and consider color coding as a means of categorization.
- Establish a seating arrangement in cooperation with the student; maintain consistency.
- Provide digital rather than face clocks whenever possible.
- Provide a physical outlet such as a "squeeze ball" to enable a longer seating period for the student.
- Establish consistent and clear routines.
- Work with guardians to establish consistency between school and home.

- Think ahead about fire drills, tornado drills, etc. Plan a consistent routine for the student and a peer helper.
- Alert substitute teachers in advance; whenever possible, another adult familiar with the child should be in the classroom to help.
- Establish consistency and some form of advanced organizer to help the student become attentive to transitions, e.g., cues, signal, music, lights.
- Use multimodality instructional processes whenever possible: physical movement, role-playing, manipulatives, art, puppetry, pictures, tactiles, etc.

Traumatic Brain Injury Disabilities

Definition

Traumatic brain injury (TBI) was added to the list of very-low-incidence disability categories recognized by the government in the 1990 IDEA. The classification applies to any injury that results from external force and that causes a decreased function in either physical or psychological ability. This category does not include injuries sustained at birth, congenital injuries, or degenerative neural disorders (Cartwright, et al., 1995).

These impairments may be either temporary or permanent and may cause partial or total functional disability as well as psychosocial maladjustment. In summary these impairments include the following:

- Physical impairments: speech, vision, hearing, and other sensory impairment; headaches; lack of fine motor coordination; spasticity of muscles; paresis or paralysis of one or both sides; and seizure disorders, balance, and other gait impairments.
- Cognitive impairments: short- and long-term memory deficits; impaired concentration; slowness of thinking; limited attention span; and impairments of perception, communication, reading and writing skills, planning, sequencing, and judgment.
- Psychosocial, behavioral, or emotional impairments: fatigue, mood swings, denial, self-centeredness, anxiety, depression, lowered self-esteem, sexual dysfunction, restlessness, lack of motivation, inability to self-monitor, difficulty with emotional control, inability to cope, agitation, excessive laughing or crying, and difficulty relating to others.

Any or all of these impairments may occur to different degrees. The nature of the injury and its attendant problems can range from mild to severe, and the course of recovery is very difficult to predict for any given student. It is important to note that with early and ongoing therapeutic intervention the severity of these symptoms may decrease, but in varying degrees.

Classroom Accommodations

- Eliminate distractions.
- Review medications and the effect on the student.
- Be aware of limitations due to increased stress and fatigue.
- Consider a student’s frustrations when planning the testing schedule.
- Be straightforward.
- Provide repetition and consistency.
- Allow for time-out if a student needs it.
- Review directions in advance.
- Give undivided attention to the student.
- Allow for signaled response.
- Don't pretend to understand if you do not.

- Focus on what is said, not how well it is said.
- Listen patiently.
- Allow more time.
- Reinforce lengthening periods of attention to appropriate tasks.
- Review lighting and background for appropriateness.
- Eliminate background noises.
- Maximize availability of visual media and/or models.
- Clearly label items or equipment.
- Allow for direct manipulation of material when appropriate.
- Get feedback from the student.
- Provide a reader when appropriate.
- Teach compensatory strategies for increasing memory.
- For students with perceptual problems, avoid computer answer sheets.
- Allow alternative response modes (e.g., circles or dictation) for students with perceptual problems

Teachers should also consider pacing the class work in a variety of ways, including the following:

- Present information in small units.
- Allow longer time for processing information.
- Provide shortened assignments.
- Allow extra time to complete tests.
- Use active learning situations whenever possible.
- Present information in multiple modalities.
- Provide printed directions for steps involved in an activity.
- Collaborate with specialists and seek out support from aides.
- Establish priorities and keep awareness of important functional skills.
- Be positive and supportive every day when the student enters the classroom.
- Communicate to the student that they are important and appreciated.
- Remain calm and redirect inappropriate behavior.
- Avoid situations known to cause frustration.

Other Health-Impaired Disabilities

Definition

The description of a disability involving other health impairments requires that an individual have a medical condition that places restrictions and limitations on his or her activities (Best, 1992).

Smith (1998) has identified a number of causes, which include hereditary diseases (sickle cell anemia and cystic fibrosis) and infectious diseases (rubella, hepatitis, and HIV/AIDS). The IDEA additionally includes maladies such as heart conditions, diabetes, asthma, and many others.

The most serious medical conditions, such as AIDS and various cancers, clearly carry with them the possibility that students with these conditions, their families, other students, and their instructors may have to cope with death and the issues that surround dying. Vaughn, et al. (1997) provide some guidelines for approaching this issue. The authors stress that dealing openly with the issue of death is extremely important, but also caution educators that they must use appropriate official communications with parents, counselors, and medical professionals under such circumstances.

In less serious cases, educators should remember the limitations that the health considerations place on students regarding what they cannot do and what they can accomplish on their own. Clearly, modifications to reduce stress and exertion are indicated for these students.

Classroom Accommodations

- Become familiar with the impairment. If it is degenerative, learn the symptoms and progression.
- Communicate with the student, guardians, and other professionals.
- Provide encouragement.
- Always keep in mind opportunities for socialization and interaction with others.
- Use peer helpers in appropriate ways.
- Plan in advance.
- Review learning priorities in the case of extended absence, and organize appropriate makeup lessons during the regular period of instruction.
- Don't make assumptions about when and where the student needs help; offer assistance but don't insist.
- Be aware of side effects of medication and understand fluctuations. (During exacerbations, the student may appear as if intoxicated--slurred speech, staggering, unfocused eyes.)
- Plan a “take-home” packet with each unit to allow the student to work in a non-school setting.
- Consider assignments in electronic formats.
- Use electronic communication, e-mail and the Internet.
- Plan for flexible attendance and alternative testing arrangements.
- In cases of uncertainty, don't hesitate to discuss issues tactfully with the student.

Students with Disabilities Who Are at Risk

Working with students with disabilities who are also at risk is demanding and often emotionally draining. Many of the reasons why students are at risk come from factors outside of the school environment and, in many cases, are not perceived by public constituents as areas of school responsibility. Yet, if not addressed, these external factors make efforts toward student success almost hopeless.

Many at risk students have developed a belief that inevitably they will fail. Often they have instilled within themselves an attitude that adults cannot be trusted and that adults will act out against them if they make a mistake. This perception probably has built up over time and will only be alleviated over time. Successes in teaching at risk students cannot be measured in daily or even weekly performance; significant change often takes months. Regression often occurs particularly when students feel helpless or sense a threat to their relationships.

At the same time, we’ve learned what doesn’t work with at-risk students with disabilities. The traditional structures of a common course of study predicated on equal treatment being fair treatment fail to provide the necessary structure and support needed for students at risk. Many of the solutions in common practice today do, in fact, aggravate the problem. Those practices generally consist of remediation, grade retention, ability grouping or tracking, and sometimes suspension (Quinn, 1991, p. 81).

If we are to successfully educate students at risk and prepare them for a productive life, our educational system must respond to the internal and external factors that placed these students at risk. We can design programs to meet students' needs and reduce the components of risk. The following actions are found to be effective for all students, but particularly, for students who are at risk. Keep in mind that at-risk students expect confrontation and will often engage in inappropriate actions to validate the label they have been given. In this way, they can generate an affirmation that they do not belong, thereby justifying their denial of identification with the institution and the authority figures within it.

- Keep expectations high; reward effort and perseverance.
- Don't give praise or rewards that are not deserved.
- Don't single out a student more than necessary, and do actively seek opportunities that provide positive socialization experiences with peers.
- Reflect on instructional techniques and provide sufficient time for independent work when special needs can be accommodated if necessary.
- Use formative evaluation and become aware of "critical features" of concepts if the student is unable to master all of the objectives.
- Be cautious about the use of the results of standardized assessment tests.

Assessment

Learning alternative assessment strategies is also essential for educational equity. The development, administration, and scoring of assessment tools are areas ripe for bias. There is strong evidence that individual assessments are being grossly misused to classify and track students, to diagnose what is wrong with their knowledge, and in general, to grant legitimacy to practices that constrain their opportunities to learn. Blomgren (1992), in her investigation of testing, found special education students who are repeatedly tested often have increased anxiety about school, lower levels of self-confidence, and tend to blame themselves for poor performance. Programs for teachers must examine alternatives such as authentic assessment, performance assessment, and open-ended forms of assessment that allow students to communicate what they know and understand. Many students are unable to demonstrate their true level of understanding under traditional testing conditions. Using the same measure for all students with no adjustments for the conditions of testing or the reporting mechanisms could result in discouraging scores, rather than a valid assessment of what students have learned.

Summary

People with disabilities are from all societal classifications, yet more are disproportionately identified from disfranchised groups. Federal regulations mandate the use of supplemental aids and resources if an alternative placement needs to be considered. To teach in an inclusive setting, preservice teachers and practitioners need training and professional development for teaching all students. Although there has been some progress in greater uses of technology, little has been done to help general classroom teachers understand their responsibilities toward meeting the needs of all students. Interventions are lacking, such as creating and using adaptive materials, modifying lessons, selecting from alternative instructional strategies, modifying laboratory equipment to allow full participation of all students, and adapting evaluation materials for students with special needs.

Special education continues to be considered as a sound alternative and caring placement for low performing students (Pettit, p. 125). Pettit (2006) states, "When students performed poorly they were perceived as incapable without being able to connect to the regular curriculum. Teachers felt they were doing the students and themselves a favor by pushing hard for special education placements." However, when placed, students face a new world of labels. This world is described as a different world, an exiled world that will ultimately stigmatize and limit the academic future of the identified students (Brantlinger, 2004; Kliewer and Biklen, 1996).

All learners have unique educational needs. Many of the science teaching strategies used to instruct students who do not have disabilities are effective and appropriate for students with disabilities as well. However it is important that the regular classroom teacher is attentive to special accommodations that will assist in the learning process for individual students. Developing a communication foundation for learning is essential. Teachers must be concerned about building and developing interactions that expand the frequency and functions of communication. Patience is important. Communication is often one of the greatest challenges faced by students with disabilities. The risks are compounded being both educational and social.

A key principle in instructional congruence is learning with the students rather than teaching to the students. Often the achievement gap is a consequence of disengagement by students who do not see a cultural or language connection between their lives and the science they are being taught. What is unique about students with disabilities is that there are sensory or learning impairments that limit their access to information shared in the classroom. It is critical that the necessary accommodations be made to allow all students access to the resources of the educational context. So often it is the caring, engaged teacher who takes time to seek out resources and work with an individual student who has unique learning needs is the one who makes a difference.

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