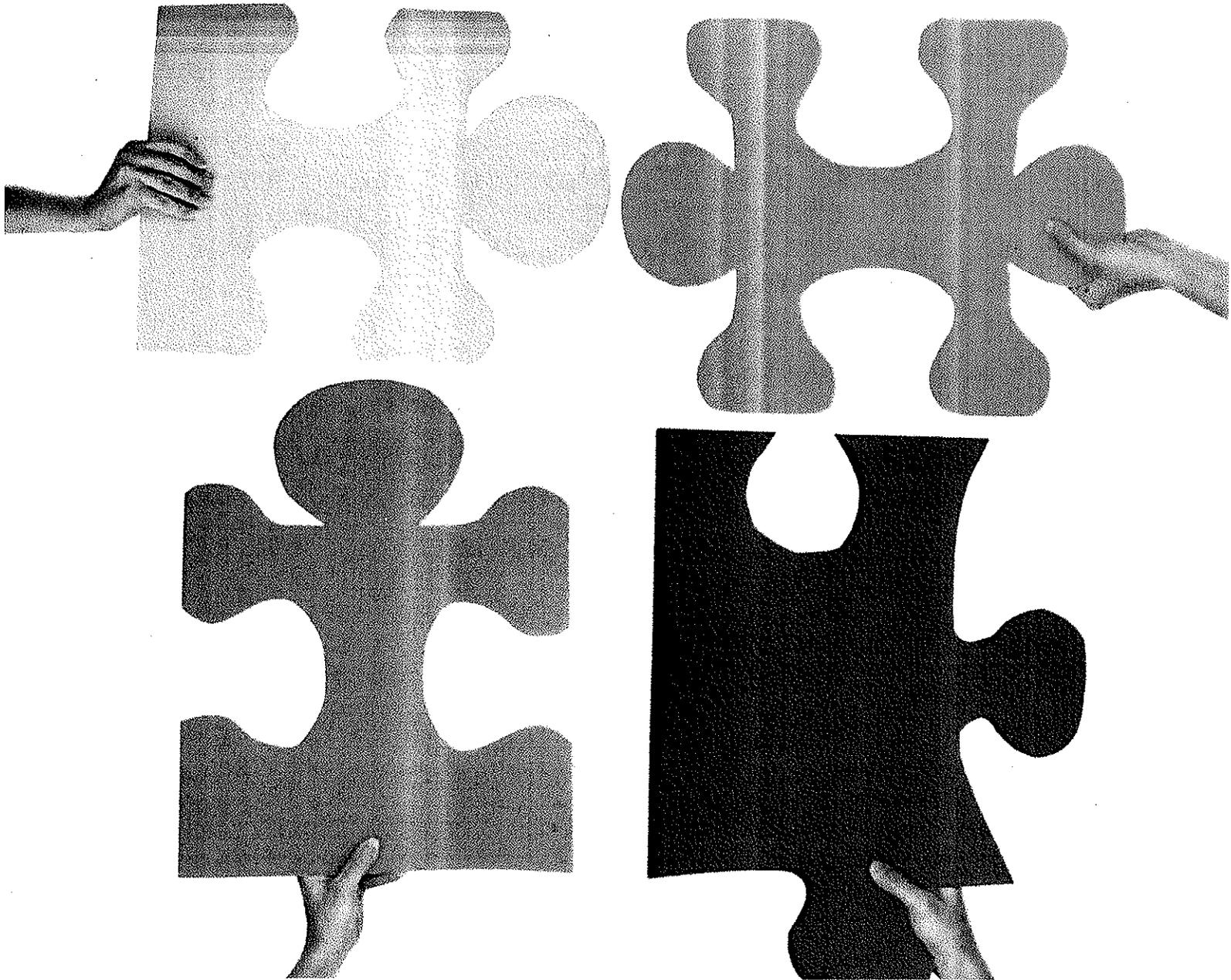


Great Science for Autistic Students

by Georgianna Saunders, Heidi Page, and Gina Wood



Autism spectrum disorders (ASDs) are neurological disorders that affect communication, behavior, and social skills (Humphrey 2008). According to the Centers for Disease Control, an average of 1 in every 110 children in the United States is affected by an autism spectrum disorder, and boys are three times more likely than girls to be diagnosed. ASDs are usually identified before the age of 3 and there is currently no cure. As of 2009, there were 1.5 million Americans affected by an ASD; ASDs are the most common developmental disability diagnosed. There are five identified ASDs, ranging from classic autism (low cognitive functioning/mental retardation) to Asperger's syndrome (AS). Students with AS can be successful in mainstream classes with appropriate education modifications and can function well if their teachers are aware of their characteristics and learning needs. Well-organized classrooms with predictable schedules and procedures provide the optimum learning environment for students with AS.

Characteristics of students with Asperger's syndrome

Students with AS are of average to above-average intelligence, have no early history of language impairment, demonstrate effortless verbal expression, but usually engage in overly formal patterns of speech, often sounding like adults. However, there are problems with nonverbal communication, including limited or inappropriate facial expressions. Their self-help skills are age appropriate, but delays are noted in fine and gross motor skills (including handwriting). Students with AS, while demonstrating social drive, have deficits in the command of social skills and "theory-of-mind" (how we imagine other people's thoughts or feelings). They are unable to understand others' feelings or points of view.

Science classes can provide excellent opportunities for students with AS to excel. These students typically enjoy the patterns and logic of science and math. Students with AS may be intensely interested by a particular topic. They will enjoy learning more about this special interest area and often demonstrate a very long attention span when studying this topic. Although school can be difficult for them, mainly due to social problems, they enjoy learning and have good memories.

One characteristic that may hinder classroom performance is impaired social functioning. Students with AS often act younger than their peers. They have difficulty understanding and using body language

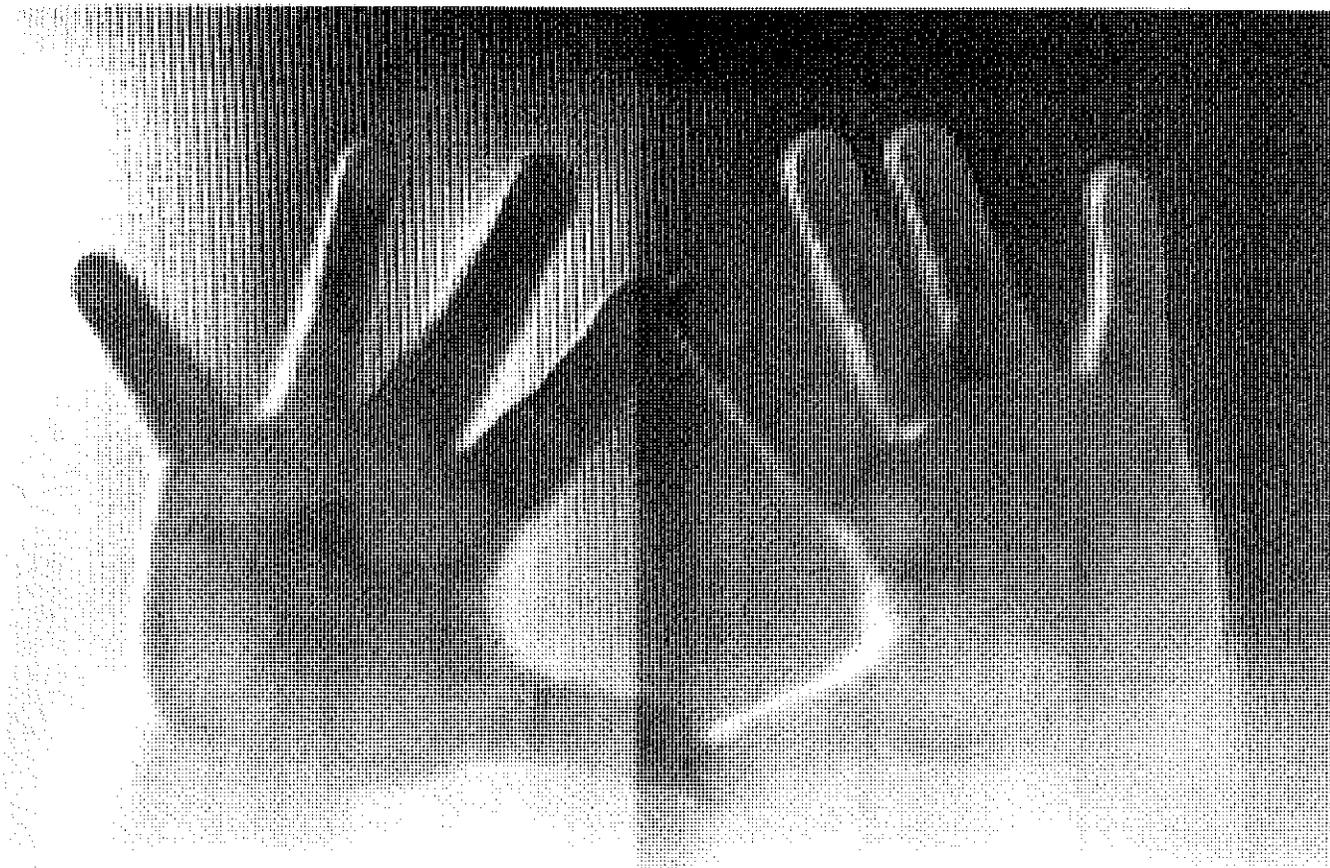
and have limited interest in other people. People with AS tend to interpret words literally, so these students may not understand typical middle school teasing, for example. These students often lack the ability to empathize or interpret feelings, which provides additional social obstacles to be overcome (Humphrey 2008). Students with AS may also have difficulty understanding metaphors, figurative language, and analogies—all commonly used in the teaching of science (Wellington and Wellington 2002).

Classroom strategies

Because students with AS cannot organize themselves, they have a strong need for routine (Humphrey 2008). For example, they do not know what to do when there is unstructured time during group work or a lab. Working in groups can be very difficult due to lack of structure and the need to interact with other students. In order to structure the environment for these students, the teacher must create a detailed schedule of daily events and place it on AS students' desk or notebook. During transition times, offer ideas for some ways students can be helpful or productive (e.g., read science news). If students with AS do not know what they are supposed to be doing, disruptive behavior becomes likely. Help students with AS by minimizing distractions in the classroom. These students only need to have what they are working with at the workspace (e.g., one piece of paper, one pencil; don't have the book out if you are not using it). Seat students with AS at the end of a row instead of in the center in order to increase personal space. During instruction, watch students with AS to make sure they stay engaged in the lesson. They may be easily distracted and fixate on an unimportant detail rather than following the lesson as intended.

Handwriting and other fine motor skills are difficult for students with AS; often they intensely dislike taking notes and cannot read their own writing. If the verbal notes are given too quickly, these students can become overwhelmed and stop trying to understand. They will fail to ask for clarification or will ask for too much clarification (e.g., obsessing about an unimportant detail). Students with AS can have difficulty transferring information from board to notes, but can usually copy from one paper to another if both are on their desks; they also may prefer typing.

Many of these students are oversensitive to stimuli such as bright lights, unusual smells, loud noises, constant noises (clocks ticking), and the temperature of the



classroom. These stimuli can greatly disturb students with AS and interfere with learning. Unfortunately, sensory phenomena are common in science classrooms. Students with AS thrive on familiarity, so any changes in the classroom environment can cause them great distress. These students can be very impulsive and may not follow safety instructions if they are distracted. Paula Kluth (2004) describes many ways in which teachers can minimize sensory distractions for students with autism.

Students with AS can often read text very well, but they don't necessarily fully understand the text. Visual aids can facilitate procedural and conceptual understanding. Written instructions should be bulleted, numbered, brief, and well spaced on the page. Pictures or drawings could be added to the written directions to clarify meaning. For example, digital pictures of the laboratory equipment can be added to instructions for a laboratory. Give specific instructions, one at a time. Simple, hands-on experiences help students with AS learn, but these experiences cannot be too complex. Modeling and demonstrations will help students understand directions. Use physical models whenever possible.

Students with AS may learn concepts more readily than they learn terminology because they like to see the big picture. However, these students don't generalize well, so you have to make the connections between terms explicit using diagrams and concept maps. These students will learn terminology in context. Students with autism spectrum disorders learned significantly more science content (four times more) when they experienced instruction with concept mapping than with conventional instruction (Roberts and Joiner 2007). The researchers attribute the learning gains to students' ability to concentrate on the relationships between terms seen in the concept map rather than having to concentrate on the individual terms themselves. Unfortunately, many students with AS will not be able to apply a concept to a new situation without instructional guidance because they will not independently generalize from one situation to another.

Inquiry learning

Students with AS are typically motivated by different things than their classmates. Most middle school

students are rewarded by opportunities to interact socially; however, this is not the case for AS students. They are motivated by time spent doing something related to a special interest area, using a computer, or reading. Students with AS will pursue a special interest area with incredible intensity (Kluth 2004).

Students with AS can participate in some types of inquiry lessons, but they will not know how to proceed in an open inquiry lesson. It may be necessary to provide additional direction for students with AS in order for them to accomplish the objectives of the inquiry lesson. If it is possible for students to use science process and inquiry skills to investigate a special interest area, the likelihood of student learning and retention increases.

Learning and using science process skills

Because of their learning styles and preferences, students with AS can do very well using basic science process skills. However, some skills are more problematic (e.g., exploring). Basic science process skills include the following:

- **Observing:** Students with AS can excel in making observations, but you have to give them sufficient time to work. Because these students are detail oriented and very aware of their senses, their observations may be the most detailed ones in the class. "Description of phenomena through direct observation may appeal to the visual preference" of these students (Humphrey 2008).
- **Asking questions:** Because good science questions stem from good observations, these students can form very good questions, particularly if they have sufficient time.
- **Recording data:** Due to their attention to detail, students with AS may excel in keeping records of data. This is especially true if they are using teacher-made data tables or computer applications.
- **Exploring:** Because students with AS are bothered by a lack of structure, they will not do well with long periods of time for open exploration.
- **Measuring:** These students can use measurement tools well if they have been trained in precisely how to use them and if they are interested. Unlike most students, they won't jump in and try to use a tool if they are uncertain.
- **Solving word problems:** Avoid using word prob-

lems, as students with AS are distracted by irrelevant details.

- **Using formulas:** Students with AS can apply formulas if they have been shown explicitly how to use the formula, but they typically have difficulty choosing a formula to use. However, many students with AS are very good at math.

As with most middle school students, students with AS will struggle with developing appropriate hypotheses, controlling variables, designing an experiment, interpreting data, and drawing conclusions. However, there are many scientists who have AS, so you can expect students with AS to perform at least as well using the science process skills as students without this disorder. ■

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