

A Neurobiological Approach to Supporting Individuals with FASD in Educational Settings

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Good Morning!

Today I want to take you on a journey to explore how intricately our brains and bodies are connected. This information sets the foundation for understanding how we have to move beyond a solely brain-based approach, to an integrated neurobiological approach to understanding and nurturing learning and behavior. There may be a number of topics covered today that you have not thought of before in an educational context. For some, parts of today's content may be brand new information. As we delve into the topics, I encourage you to keep an open, and inquiring, mindset, approaching each component with curiosity – and with the following questions in mind: **“What if we integrated all of these neurobiological aspects of being into our educational plans? What would we do differently to support students in this way?”**



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There is an age-old debate about which is more influential, Nature vs Nurture. Yet, for centuries, we've gotten it wrong. We now know that nature and nurture are inextricably intertwined: that nurturing alters nature in every moment, literally changing our brain and genes and other biological functioning in the exact moments we are experiencing life. Our biology also influences how we interact with the world, how we perceive information, and how we respond to it. Each action we take – or don't take – and every experience we have, are intertwined to create a unique and individualized body that experiences the world like no other.

These unique individuals are the students in our classrooms. They are our children. And they are ourselves. Each of us brings our own biology to the table – everything we've been given from the make-up of our earliest cells, combined with everything we have experienced.

So today, I am going to ask you questions – not for immediate answer, but for contemplation. I am asking each of you to consider how the neurobiological components discussed today impact students and educational systems, and use this information to advocate for appropriate analysis of these factors – and changes to existing practices.

Over millennia, Humans....



... have evolved to be Social Beings. Our brains have come to expect social relationships that include interdependence, shared goals, and attention (Holt-Lunstad, et al., 2017). The social relationships we engage in can have a protective influence on our lives and our health, or they can put us at risk for significant health challenges and even early death.

“Full social participation is such a fundamental human need that research since the 1900s has found the lack of social connections increases the odds of death by at least 50% (1,2).” (Yang, et al., 2016, p.578)

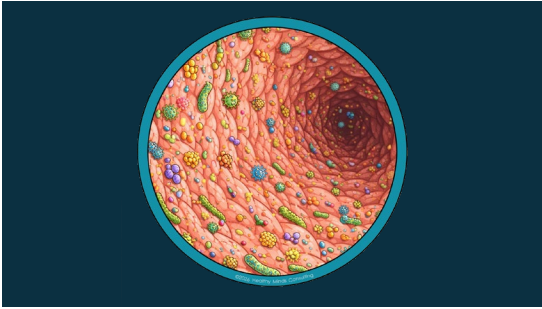
Social isolation - or low social support - can impact our immune, neuroendocrine, and metabolic systems. How many of the over 400 co-occurring conditions with FASD are exacerbated by not having sufficient social supports?

Should this information influence our decisions when creating educational plans for students? Do we need to increase our attention to – and support of – students’ social needs? And not just the opportunity to socialize with others, but the opportunity to make – and keep – deeply connected friendships. If we prioritized how we nurture these types of connections between students, how would our approaches change?

I don’t have all of the answers to these questions. They are multifaceted and multidimensional and must be considered on a student-by-student basis, as well as in the larger context of how we structure and run our educational settings. But I encourage each of you to begin contemplating how these concepts can change the way we approach educational support for students.

If we facilitate relationships in our lives – and in our students’ lives - that promote connection, laughter, and joy, as well as those that support and nurture us, it can have a profound impact on our health and well-being.

Humans have also evolved as symbiotic beings...



... Our bodies have trillions of microorganisms living on, and within us. These are bacteria, viruses, fungi, protozoa and archaea that help our bodies function effectively. The types, quantities, and diversity of these microbes has significant influence on our current and long-term health - both physiological and mental health. They can affect our mood and even impact behavior.

This may sound like something out of a Star Trek episode, but a growing body of research is demonstrating how the microbiome is intricately connected to human health and well-being.

Let me share some examples regarding the significance of the microbiome both on immediate and long-term health.

- Scientists have shown that by looking at the microbiome make-up of an individual with certain types of cancer, they are beginning to predict who will respond well to typical treatments and who won't. (Oh et al., 2021; Hajjar et al., 2026)
- Babies born vaginally versus those born via c-section have grossly different microbiomes.... with the babies born vaginally having microbiomes similar to their mother's, and the babies born via c-section having microbiomes more aligned with the hospital environment. (Shao, et al., 2019) Babies born via c-section are also more likely to have long-term health challenges. (Chua et al., 2024)
- Depression, Anxiety, Bipolar d/o, & Autism, – are all impacted by the types of microbes living in our gut. (Xiong et al., 2023) Do any of these sound familiar with regard to overlapping diagnosis and FASD? (Hagan et al., 2016)

How might the microbiome contribute to the co-occurring health conditions known to be associated with FASD?

There is preliminary research demonstrating a link between FASD, the gut microbiome, and neuroinflammation. (Busayli et al., 2025) More research in this area will be essential to understanding and providing effective, individualized, health and medical interventions.

For more than a century we have thought of bacteria and viruses, forms of microbiota, as bad for us; something that causes disease and death. But what we have discovered is that these elements of nature are also essential for human health.



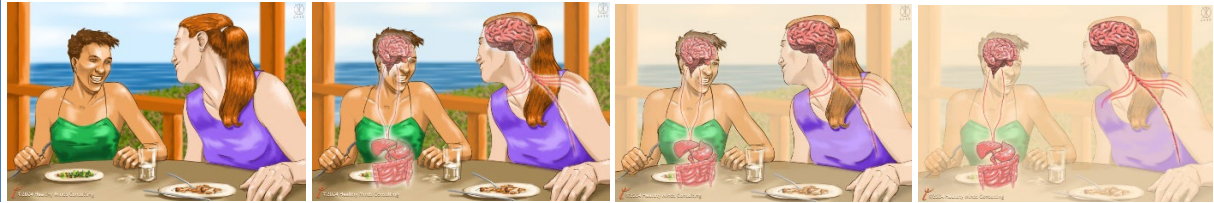
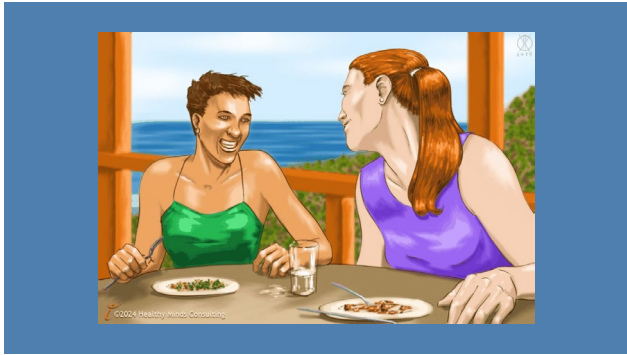
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Factors such as where we live, how much connection we have with nature, and even being around animals can impact our microbiome. Spending time in nature with trees, dirt, and fresh air all offer positive benefits to our microbiome. (Dietert, 2016) Our species has even evolved to benefit specifically from animals such as dogs, with regular contact being supportive of healthy human microbiomes. (C. Jiang et al., 2022)

So, how do we integrate this knowledge into schools? Some schools have trees and grass and dirt areas for students to play and interact. Others have asphalt and cement. How might these differences impact students?

You might be wondering why I am bringing up the microbiome in a presentation about FASD and education – It is my hope that by the end of this presentation the microbiome will be one of many components that you will be keeping in mind that had not been previously considered in an educational context.

In addition to how our bodies interact with the world around us, they are also significantly impacted by what we put in us....



The types of food we eat significantly impacts our physiological and mental health through its alteration of our microbiome. Eating ultra processed foods reduces microbial diversity – something that is important for health; these changes are associated with increased inflammation and even cancer. (Rondinella, et al., 2025)

Eating foods that provide our bodies with the needed vitamins and nutrients supports a healthy microbiome and allows our body to function more effectively.

That fiber that you’ve always heard will “keep you regular”? That’s food for your microbes!

Our gut – where a large portion of our microbes are housed – is connected to our brain via the nervous system. You may have heard of this referred to as the “Gut-Brain Axis”. And the primary transporter of information to and from the gut and brain, is the Vagus Nerve.

This nerve travels from our brain to our gut and other organs. Because there is direct innervation directly between the gut and the brain, they talk to each other frequently! When you have a “gut feeling”, your body is literally transmitting that information to your brain. In fact, the majority – more than 80% - of brain and gut transmissions actually *start* with the gut!

Serotonin – A neurotransmitter most of us have heard of, is involved with mood regulation. What isn’t as commonly known, is that over 90% of the body’s serotonin is actually produced in the gut! (Appleton, 2018)

These discoveries support the importance of understanding and promoting gut and microbial health when considering treatments not only for health or medical needs, but also for mental health and behavioral needs as well.

If eating certain foods contributes to behavioral problems, are those the foods we want served for school lunches?

When we create a health plan for a student with Crohn’s disease, we may ensure they have regular and uninhibited access to the restroom, but are we also considering the fatigue, ‘brain fog’, and anxiety that are typically experienced as well?



The same Vagus Nerve, and its bidirectional influence, is central to Polyvagal theory...

This theory, which is now supported by over 30 years of research, looks at how the Vagus nerve transmits information to and from the body and brain in order to detect threat or safety – a function of biological survival.

Neuroception is the term used to describe our nervous systems' way of detecting threat or safety from our environment and shifting our bodily responses accordingly. (Porges, 2006; Porges, 2021)

These threats could be external – such as a lion chasing us because we look like a tasty lunch, or our boss reprimanding us for not getting a project turned in on time; and it can also be internal, such as constipation, or inflammation in one or more of our internal organs.

No matter where it comes from, the body reacts to a perceived threat by triggering the sympathetic nervous system into action which triggers a fight/flight reaction: We either try to fight off the threat (if we feel like we can successfully do so), or we flee from the threat.

In more severe perceptions of threat, the body will sometimes go into a freeze state where we are less – or completely – immobile and we shut-down. These are not reactions we consciously choose – they are physiological responses to perceived threat.

The flip side of this is safety. When our bodies perceive us to be in a safe environment, the parasympathetic nervous system helps regulate our body in ways that allow us to socialize more effectively, think more clearly, and feel more connected. Being in a state of Social Engagement, when our body is regulated and our nervous system detects only safety, is pertinent to learning and pro-social, socially accepted, behavior. (Porges, 2021)

So what does this look like in a school setting?

Well, when that student you called on – whom you know knows the answer to the question – freezes up and can't answer? Being called on in front of the entire class may be overwhelming to their nervous system – to the point where they literally can't talk.

When we talk about students who elope from class or campus – Are we considering that this could be a nervous system response? Are we approaching our interventions from this perspective? And if so, what might we do differently?

How can we set up our classroom and school environments in ways that support student engagement through the nurturing of student's – and educators' - nervous systems?

Neuroception is just one of our many senses...



We've all heard the 5 senses that are taught in school: Vision, Hearing, Taste, Smell and Touch. But we have other senses as well.

We have Proprioception – our body's ability to sense its own position, movement, and location in space (<https://my.clevelandclinic.org/health/articles/proprioception>).

Vestibular – our body's sense of balance and spatial orientation, and

Interoception – our awareness of what our internal body and organs are sensing.

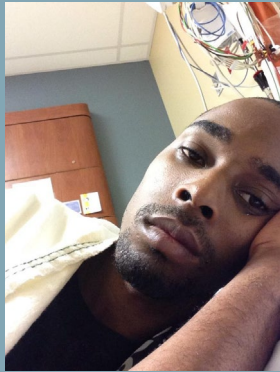
In addition to the Neuroception we discussed, there are others such as Thermoception – identifying heat or cold sensations,

Chronoception – identifying the passage of time, and likely more...

Our bodies sense things in many ways and *all* of these various sensory inputs provide us with information that impact how we perceive and interact with the environment around us, including the people we are with.

All of these inputs are occurring for students in the classroom. Their bodies are perceiving so much more than we typically think about, yet they – sometimes in subconscious ways – still react to these phenomena; they impact the student's ability to focus, to sustain attention, and to retain information.

When discussing sensory input – especially with individuals with FASD – we would be remiss not to also include our body's experience of health and illness.



When our body is healthy and functioning optimally, it makes it easier for our nervous system to stay regulated, and we are likely to have an easier time engaging in school activities. When we have internal distractions – whether we are attuned to those or not - it can significantly impact our ability to think and learn.

Whether it's sitting in a presentation when you really need to run to the restroom, trying to drive when you have a migraine, or the chronic – non-apparent – fatigue that comes with long-covid or a yet-undiagnosed health condition, our bodies' internal signals impact our actions and our ability to function.

Now, let's picture yourself fatigued from jet lag, constipated from travel, and hungry from missing breakfast because you overslept – How much harder is it to focus on learning new things – and a presentation dense with interconnected topics, such as this one – when you have all those internal factors pulling for your attention and disrupting your ability to fully integrate everything in the manner you desire?

What about our students who may be experiencing severe menstrual cramps, depression, or those experiencing chronic illnesses - Are we truly taking the time to consider how these factor into the student's ability to synthesize new information, or perform on tests? Do we consider these factors when they are lashing out verbally at peers?

Whether your body is working efficiently or not has a much more significant impact on our overall functioning than we typically consider.

With FASD, the research is just diving into many of the underlying physiological differences that likely contribute to the Over 400 Co-Occurring conditions experienced. (Popova, et al., 2016) Let alone, the exacerbating factor of having multiple health-related challenges simultaneously.

These health impacts are forms of trauma.



An infant's stay in the NICU is increasingly being recognized as a *first* Adverse Childhood Experience – ACE. (Malin, et al., 2024) And yet, I believe there is an argument for prenatal exposure – as well as the experiences in utero – to be considered as early ACEs as well.

The research on ACEs has provided evidence that experiencing trauma creates lasting changes to the brain *and* microbiome that impact both current and long-term health outcomes. (Herzog & Schmahl, 2018; Wiley & Higgens, 2024)

Even seemingly small woes can be experienced by the body as traumatic. Being told that project you worked so hard on was insufficient for a passing grade; Having a peer tease you about a physical feature you have no control over; experiencing a bad bout of allergies during spring winds. All of these can potentially be experienced as Microtraumas - and if those build-up within us and we are not able to mitigate each of those experiences, they can add up and cause our brains and bodies havoc.

But the opposite is also true: Our experiences, our microbiome, and our brains can influence our health and functioning in positive ways too. And that's where we can begin to make a difference in the educational experiences of individuals with FASD.



Despite the reduction of neuronal connections and the alterations to those connections that are the result of prenatal exposure to alcohol (Long & Lebel, 2022), our brains remain adaptable.

When we have studies noting that early intervention, including appropriate diagnosis and FASD-informed supports, leads to improved outcomes (Streissguth, 2004), there is validation that neuroplasticity – a rewiring and reorganizing of the brain – is occurring.

When looking at neuroplasticity in the context of education, we want to consider that one of the best ways to learn and retain new information is to experience it over and over again. Doing so helps create a default pathway for the new skill. Thinking about learning and behavior in this way can shift the approaches we take to support students.

What do we do with this information?

So, how do we weave all of this together? And how do we use this knowledge to inform educational decision-making?

To answer this question, I am going to take you through a case study to find many of the touch points where educators were provided with information that is pertinent to the student's educational success.

Compounding Effects

- Prenatally exposed to alcohol
- Premature birth
- Months-long stay in NICU
- Adopted
- Difficulties with sleeping and eating
- Vision difficulties (Intermittent exotropia monocular OS, Refractive amblyopia, Deficient saccadic eye movements, Exophoria, Convergence insufficiency)
- Hearing difficulties (Mild low frequency conductive hearing loss)
- Eventual diagnoses of Encephalopathy, Neurodevelopmental Disorder secondary to in-utero exposure to substances, GAD, ASD, ADHD, POTS, GERD, Functional constipation
- Language Disorder (Social communication, Receptive), Nonverbal Learning Disorder

When we look at the Background & Diagnosis for this student, it is important to note how each of these challenges has a compounding effect on the student's overall ability to learn and function in a meaningful way on any given day.

This student was prenatally exposed to alcohol, changing the wiring and the functionality of their brain.

They were born without benefit of full-term gestation, being thrust into a sensory-bombarding world before their nervous system was fully developed.

Any stay in the NICU has potentially traumatizing impact on a child, with lack of consistent human touch, pokes and prods from well-meaning health professionals, bright lights, and constant beeping and other disruptive noises that are not soothing to the nervous system.

Adoption can come with trauma as well, even if it is not something the individual is cognizant of. The change from the mother that carried them to a new family has an impact, even when the new family is amazing and attentive and loving.

Lack of sleep or broken sleep can significantly impact learning, mood, memory, and attention. (Hershner & Chervin, 2014; *How Sleep Affects Your Health* | NHLBI, NIH, 2022; Hyndych et al., 2025)

Vision difficulties can contribute to reading challenges, like struggles with reading fluency that contribute to reading comprehension challenges as well. (Sarkar, 2026)

Even mild hearing loss can contribute to significant challenges with academics and social interactions (Elbeltagy, 2019; Daud et al., 2009)

In addition to the discomfort associated with gastrointestinal difficulties, these can also lead to secondary challenges such as lack of sleep (Jung et al., 2010) that cause additional impediments to learning. (Hershner & Chervin, 2014)

Language processing difficulties have the potential to impact the student's ability to comprehend instructions or social cues. (Bauminger-Zviely et al., 2019)

Any one of these challenges can have a significant impact on a student's learning and behavioral presentation. Then imagine the impact on the student who is experiencing all of these at the same time!

Each of these ends up exacerbating the others.

Sensory Processing

Traditional Lens

- Consider evaluation by OT
- Provide noise-cancelling headphones (and other accommodations)
- Provide a sensory diet

Neurobiological Lens

- Potentially related to NICU trauma experience
- May overlap with neuroceptive sensitivities
- Potential influence on cognitive and behavioral functioning
- Assess for need for accommodations
- Consider evaluation by OT

So let's look at a few of the challenges this student experienced at school and how those are perceived through a traditional lens, versus how those are perceived when we look at the student using a neurobiological perspective, integrating all of the concepts we've discussed so-far today.

If we take Sensory Processing and look at it first through a traditional lens, we would likely consider having the student evaluated by an Occupational Therapist who could look at appropriate and supportive accommodations and tools the student could use to effectively meet their sensory needs without disrupting others in the classroom. These are all excellent options and I encourage school teams to take these steps.

When we shift to a Neurobiological lens, we tend to incorporate **more** data – both from the student’s history and by looking at nuanced aspects of sensory processing, such as interoception and neuroception.

Traditional Lens

- Consider evaluation by OT
- Provide noise-cancelling headphones (and other accommodations)
- Provide a sensory diet

Neurobiological Lens

- Potentially related to NICU trauma experience
- May overlap with neuroceptive sensitivities
- Potential influence on cognitive and behavioral functioning
- Assess for need for accommodations
- Consider evaluation by OT

The neurobiological perspective incorporates many of the things that are being done and adds to it, deepening how we view the student and their needs.

Language Disorder(s)

Traditional Lens

- Evaluation by SLP
- Language Therapy

Neurobiological Lens

- Evaluation by SLP
- Language Therapy
- Accommodations
- Communication plan

Now, let's move to Language Disorder(s). Through a traditional lens, we would have the student evaluated by a Speech and Language Pathologist and, if they were found to be in need, provide them with Speech and/or Language Therapy.

Again, these are not inappropriate! We just want to take it a step further by looking at the additional and underlying components that may be influencing the existence of – and the manifestation of – the language difficulties the student is experiencing.

I have had clients get creative with designing a communication plan in lieu of a traditional behavior plan, because the student's behaviors were all rooted in their communication and language difficulties.

Working in collaboration with the Speech and Language Therapist – and even pulling in other professions – could be beneficial.

Traditional Lens

- Evaluation by SLP
- Language Therapy

Neurobiological Lens

- Evaluation by SLP
- Language Therapy
- Accommodations
- Communication plan

When we think about ourselves as Social Beings, we need to take into consideration how “Being able to infer the intentions, thoughts, and feelings of those around us is critical to engaging in our social world.” (Halt-Lundstad, 2017) For some individuals with FASD or other neurodevelopmental disabilities, accurately inferring others' intentions or feelings is extremely difficult and can lead to communication breakdown and difficulties with peers, including having a significant impact on social relationships. (Zieff & Schwartz-Bloom, 2008)

Gastrointestinal Issues

Traditional Lens

- Common issue, not needing special attention
- Medical issue

Neurobiological Lens

- Symptom of microbiome dysbiosis
- May impact gut-brain axis
- Potential influence on cognitive and behavioral functioning
- Assess for need for accommodations

Now let's take into consideration this student's GI difficulties. Most of us don't consider constipation when developing educational plans for students. It's often seen as either a medical issue or just a common occurrence that everyone deals with from time to time, but nothing worthy of specific accommodations or other considerations.

However, when we consider this symptom through a neurobiological lens, we can recognize it as a symptom of the student's microbiome being imbalanced. We can use our knowledge of the gut-brain axis to acknowledge that there will likely be an impact to the student's learning, potentially including cognitive and behavioral functioning during these times.

We can approach the situation by learning more about how this student's dysbiosis – the imbalance in their gut - may impact their educational functioning. If we are tracking behavior for this student, correlating that with bathroom breaks may provide relevant information for the educational team, as functional constipation is known to be correlated with an increase in behavioral challenges (Chiappini et al., 2025). We would likely be more attuned to the possible need for accommodations to support the student at times when these symptoms are present.



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So how do we integrate what we know of human biology and neuroscience and apply that to Educational environments?

Let's take a minute to touch on some key factors that can influence the biological aspects of human functioning – taking into consideration everything we reviewed at the beginning of this presentation – and looking at how we can create environments that are supportive of student's needs through a neurobiological lens. Then we'll apply these to our case study.



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Nervous System regulation awareness

When we know about neuroception and how our bodies are designed to perceive threat and safety in order to keep us alive, we can reframe the responses of fight, flight, and freeze as protective – our nervous systems are ensuring that we engage in the behaviors necessary for survival.

We can look at a student's behavior as a function of the student's nervous system being dysregulated and focus on techniques that support nervous system regulation. You'll hear more about this in Shannon's upcoming presentation on Behavior.



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One of the best things we can do to support a regulated nervous system is to provide authentic Connection – meaningful moments with others where we can feel safe, heard, and understood. (Delahooke, 2026)

Co-Regulation is another key factor that supports nervous system shifts. When we – the adults – take a leadership role by ensuring our own nervous systems are regulated first, we both set an example for the student and we ensure that we are not exacerbating their symptoms through our own nervous system’s dysregulated state. (L. L. Desautels, 2020) “We’re the adults. We go first.” (Desautels, n.d.)

Taking care of our nervous systems is something that can be incorporated into educational curriculum. The practice of Applied Educational Neuroscience teaches the use of Focused Attention Practices to help regulate the vagus nerve and help our nervous systems connect with a sense of safety that allows for learning to occur. That sense of neuroceptive safety is often what’s missing when students are exhibiting behaviors that are not supportive of their learning or social progress. And because our bodies literally do not hear (Emami, 2024) or process language (Cardoso et al., 2019; Porges, 2022) as well when we are dysregulated, we **have** to focus on nervous system regulation before the student will be able to access other educational demands.

Sometimes we may not be sure of what is causing the disruption for the student.

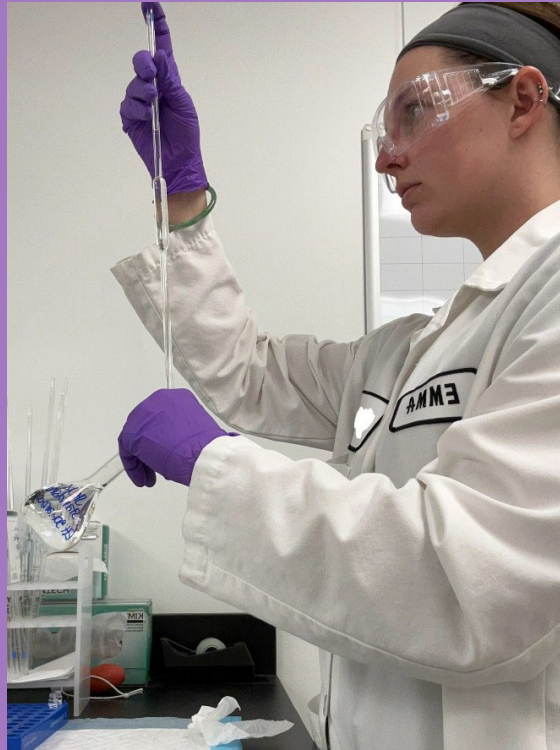


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This is when we need to get curious.

Instead of blaming the student for not turning their work in on time, we could respond with Curiosity and explore *why* it wasn't turned in.

- If the student is having memory challenges, how might we support that as we create their educational plan?
- Maybe the student is struggling with executive functioning and organization and planning are consistent challenges. We can address those challenges through the addition of appropriate accommodations.
- It's also possible that the student's explanation for why they didn't get their work in isn't actually a lie – it could be that their brain has confabulated the details that were missing in a genuine attempt to explain what happened.

When we take the time to really get curious, ...



...we can delve deeper and work to find the Root cause of the challenges. Instead of assuming that the student is “attention-seeking” and writing a plan to thwart this, Let’s look at *why* they are seeking our attention. What is the underlying need they are trying to meet? Are they looking for connection? Do they want to be heard? Do they need support but don’t know how to ask for it effectively?

Looking for the underlying causes facilitates our ability to truly meet the child’s needs.



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Shifting from a behavior modification lens to a neurobiological lens also supports our ability to be empathetic. When we understand that Behavior is biology, it helps to deflect the personalization of the behavior. Because when our own nervous systems are feeling threatened and our bodies are in defense-mode, we tend to take things personally rather than truly being able to see and hear what the student is trying to tell us.

When we are attuned to students as human beings – with all of the factors that go into that – much more than I’ve even touched on today – we are able to connect with one another more fully... we look beneath the surface to see what might really be going on or what might be influencing the student’s behavior and actions, and we can come to them from a place of empathy – from one human being to another.



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And finally, an extremely important factor to incorporate into any support plan for students are their unique strengths. We can utilize the student's strengths to support their areas of struggle,

- If they like to argue – sign them up for the debate team!
- If they learn best when moving their bodies, consider having them run from one side of the room to the other between each Math problem.

Ensuring the student has ways they can excel at school is essential for self-esteem and self-confidence – and both of those contribute to how the student will show up at school. (Akbari & Sahibzada, 2020)

Education is about far more than classroom knowledge. We are preparing students to go out into the world and it is sooo important for them to know that they have strengths and how they can really lean into those.

Difficulty with Attendance

Traditional Lens

- School refusal (intentional/choice-driven behavior)
- Parents are not *making* the student go to school (i.e. allowing the student to stay home)

Neurobiological Lens

- Does the student feel *safe* at school?
- Does the student feel *connected* at school? (Do they feel a sense of *belonging*?)
- How might the student's health be impacting their attendance?
- What is their school experience like when the student does attend?

So, now that we have an idea of what supports neurobiological well-being in students. let's go back to our case study. We'll take the example of Attendance, which was a significant area of challenge for this student, and compare the traditional lens and the neurobiological lens when assessing the underlying need for this student.

Attendance issues are often described by schools as truancy or school refusal. Both of these terms imply that there is an intentional choice behind the behavior (the non-attendance at school). It also often assumes that the family is not doing their part in facilitating the student's attendance. Both of these perspectives tend to blame the student and the family for the attendance difficulties. But when we look for the root cause of what appears to be – on the surface – refusal and resistance, or noncompliance – we may get to the underlying factors that are contributing to this issue and then can effectively address those.

When we shift to looking at attendance issues through a neurobiological lens, we'll start to get curious and ask questions relating to what could be underscoring these behaviors. We would look at whether the student has a sense of felt-safety when they are at school, and whether they have a sense of connectedness or belonging when at school. We might explore what their school experience is like when they do attend, and how their health may be impacting attendance. By simply reframing the issue in these ways, we've shifted to a more empathetic view and can then look for ways to incorporate the student's strengths into our interventions to support their attendance.

...



Looking at challenges through a neurobiological lens helps us to remove the blame that sometimes gets placed on students, families, or teachers, and instead helps us to explore what the root causes may be and how we can support this student in ways that nurture them and facilitate felt-safety and meaningful connections to both peers and educators.

THANK YOU.

Citations Available at:

