

The Science of Learning and Development. In 2017, the Science of Learning and Development (SoLD) Alliance worked with a large group of leading scientists from multiple disciplines to synthesize research from diverse fields. Their goal: To infuse these findings into policy and practice decisions about the systems and settings that support learning and development. They published two research papers in the *Journal of Applied Developmental Science*. Their titles signal their importance. “Drivers of human development: How relationships and context shape learning and development” and “Malleability, plasticity, and individuality: How children learn and develop in context.” The two academic papers emphasize the importance of supportive contexts—positive relationships, experiences, and environments—to young people’s individual and collective ability to thrive, even in adverse conditions. Subsequent journal issues published commentaries from SoLD Alliance research advisors that explored the implications of the findings for advancing equity.

In 2020, the SoLD Alliance brought these findings one step closer to practitioners. They issued a shorter, more accessible brief to elevate specific findings that have significant implications for educators and learning organizations, broadly defined. The issue brief isolates eight initial findings.

Each of these findings has distinct and important implications for practice. We outline some of these implications in Table 2. The power of the findings, however, comes from their interconnections. The description of meaning-making explains why: *People make meaning by reflecting on the connections between new information and existing knowledge.* You will be better able to use these findings in your daily practice by reflecting on the connections between this new information and your existing knowledge. Narratives are more useful than lists for this purpose. In Table 1, we share our narrative road map for understanding why applying the principles of epigenetics can improve adolescent thriving, especially for young people furthest from opportunities.

Table 1. A Narrative Translation of the SoLD Alliance’s Initial Science Findings.

What works? What would you change? Who might you share these ideas with? How might they react?

All children have significant *potential* to learn and thrive because nature gives humans many more genes than will be expressed (activated). Human development, unlike the development of other mammals, spans decades. Our brains are designed to be highly *malleable*, (ready to adapt) and resilient (able to recover) when those experiences are harmful rather than nurturing. Because of this constant dynamic interaction between nature and nurture, *individuality* is the norm. There is no such thing as an average child. Many believe the bell curve represents fixed differences in human potential. It actually represents variations in opportunity. Racial and gender differences in bell curves reflect differences in opportunities much more than differences in genetics. Nurture matters more than nature.

Epigenetics explains why all *contexts* matter. Epigenetics, the study of how context changes the expression of genes, has challenged the outdated notion that genes are set in stone. The experiences, environments and cultures that combine into everyday life are the defining influences on development. We can, and should, create policies, programs, and systems that introduce experiences designed to accelerate development and offset inequitable circumstances. Epigenetics reminds us that interventions, offered in the absence of understanding the individual and collective contexts of young people’s lives, may have limited impact. This is especially true in adolescence when young people begin to traverse multiple systems and settings on their own. Young people’s previous experiences inform how they interpret contexts.

Navigating multiple contexts is why *relationships* matter. Humans are, at their core, social beings. Adolescents are hyper-sensitive to relationships. Young people can’t learn and, if given a choice, won’t return to contexts where they don’t feel they belong and aren’t challenged and respected. Relationships are the soil in which young people develop their sense of individual and collective (group) belonging and purpose. This is why it is so important to construct experiences that emphasize the *integration* of cognitive, academic social and emotional development. When one area is neglected, all suffer. Remembering this principle is difficult when staff are charged with helping youth make progress in only one area. Progress along a *continuum* is driven by the right degree of challenge (and failure). But the speed, and even the direction of progress is often uneven, and can be easily threatened if attention to other areas of development is neglected. Attention to a strength area can accelerate progress in the targeted weaker one.

Meaning making is why the developmental period of adolescence matters. Anyone who has experienced the unending “why?” questions from a toddler understands the drive to make meaning of new information by connecting it to existing knowledge. Adolescents are making meaning ...Describe MHIYs research on the adolescents’ ability to do abstract vs contract reasoning activates different connections in the brain that determine on young adult success.

[include citation]

Table 1: Practical Implications of SoLD Alliance’s Initial Science Findings (Pittman, 2024)

Finding	Research Explanation	Practice Suggestions
<p>Potential. Each young person has significant potential to thrive.</p>	<p>The concept of genetic determinism is a myth. Children develop billions of neural pathways that can enable learning and positive development. Only a small portion of genetic make-up is activated over the course of our lives. <i>There is no bell curve on human potential.</i></p> <p>Realizing their potential – finding and forming the integrated neural connections around complex knowledge and skills – depends chiefly on their experiences, environments, culture, and relationships.</p>	<p>Aggressively challenge assumptions about how what you want youth to do now defines what they can do in the future.</p> <ul style="list-style-type: none"> • Group youth by their interests, not their presenting skill levels. • Ban use of terms (e.g., stupid, failure) that describe fixed states. • Reward effort, provide appropriate challenge, and acknowledge growth. • Emphasize that there are multiple approaches to solving problems and that we learn through failure as well as success. • Support adult and youth growth mindsets
<p>Malleability. The brain is highly malleable, from birth through adolescence and beyond.</p>	<p>The tissue that makes up young brains is more easily changed than any other organ in the body. Neurological development and remodeling occur more regularly and extend for much longer periods in humans than in any other mammal. Corrective changes can happen under the right circumstances with the right supports. <i>Ability to learn does not end. Adversity in life is not decisive.</i></p> <p>These processes begin in utero and continue throughout life. Two developmental periods are highly sensitive to experience: early childhood (<5) and adolescence (10–25). The developmental tasks in adolescence are identity formation and complex skill building.</p>	<p>Provide rich opportunities and make time for small supports and frequent course adjustments to respond to real-life signs of individual or collective adversity.</p> <ul style="list-style-type: none"> • Share the research findings. Help youth understand the importance of this period in their lives. • Be specific. Make explicit connections between the learning opportunities provided and the complex skills they support. • Provide challenging opportunities to practice and apply learning. • Be flexible.
<p>Individuality. Every child learns and develops differently.</p>	<p>Every young person’s learning paths are unique and dynamic. They are the result of the interactions between their unique neurological structures, genetic expression, backgrounds, and personal experiences. The recurring patterns and overlaps in learning paths that make it appropriate and practical to develop different learning experiences for different age groups.</p> <p>But the uniqueness and unevenness of each child’s learning process means that we need to lose the concept of “average. <i>There is no “normal” or “average” learner.</i></p>	<p>Expect variation, especially in adolescents.</p> <ul style="list-style-type: none"> • Take time to get to know youth as individuals. Start by asking them to share three things about themselves. • Build on strengths while addressing needs. Ask young people how they approach new learning experiences. Have a vocabulary that acknowledges different learning styles (e.g., kinesthetic, logical, social). • Make sure you provide opportunities that integrate different learning preferences as well as changing skill levels.
<p>Context. Experiences, environments, and cultures are the defining influences on development.</p>	<p>The experiences that shape us are unique. Our responses to these experiences are equally unique. Every experience is contextualized. At the broadest level, young people’s culture; community; and racial, economic, and social status shape the nature of learning environments available; the perceptions and expectations of the adults and peers in those environments, and, consequently, the ways in which they experience and respond to these environments.</p>	<p>Learn about who and where youth are when they aren’t with you.</p> <ul style="list-style-type: none"> • Find ways to have young people share their stories early on in the program. Incorporate these into your planning. • Take time to respond to events outside of the program (large or small) that multiple youth may have experienced that challenge their identity or sense of safety (e.g., bullying because of racial, gender, sexual orientation, or SES status).

Finding	Research Explanation	Practice Suggestions
	<p>The way adolescents learn and develop depends particularly on where and how they discover who they are. Poverty, bias, racism, sexism, heterosexism, ableism, exposure to violence, and abuse threaten development. Learning environments can be designed for positive development if these larger contextual influences are understood and mitigated. Youth with different life experiences can respond to the same learning opportunity very differently.</p>	<ul style="list-style-type: none"> • Do not assume that what works for some youth works for all. Take time to connect with those least engaged to learn why. • Consider making (and monitoring) team groupings and assignments that provide opportunities for positive peer interactions with youth with different contextual and lived experiences.
<p>Relationships. Strong, trusting relationships are essential to learning and development.</p>	<p>The presence and quality of our relationships may have more impact on learning and development than any other factor. One way to see the power of relationships is to examine the limbic system, which is the learning center of the brain. It is extremely sensitive to experiences and plays a role in how we control attention, focus, memory, and emotion. Two hormones fuel and fire this process: Cortisol, the response to stress, makes us irritable, and hinders our ability to concentrate. Oxytocin is released when we enjoy feelings of trust and love. It reduces blood pressure, helps us manage stress, and can alleviate some of the negative effects of cortisol.</p> <p>Emotion and cognition are inextricably linked. Love, trust, mentoring, friendship can help mitigate the damage caused by larger forces we can't control like poverty, discrimination, and violence. Environments filled with relationship bring hope.</p>	<p>Remember, relationships are bi-directional, and strong relationships build on this bidirectionality. Our bodies respond to stress and joy in similar ways:</p> <ul style="list-style-type: none"> • Acknowledge stressful situations that occur within or outside of the program. Ask young people how they feel about the stress. • Talk about what you feel and how you are managing stress. • Look for signs of stress in individual youth as you start your day. Remember, what happens outside is often brought in. <p>Developmental relationships are more than caring. But expressing and providing care are key. Youth know that it is your job to get to know them. Personalizing the experience, going the extra mile, even in small ways, matters. Youth don't experience caring as much as we think we are providing it.</p>
<p>Integration. Intentional integration accelerates learning.</p>	<p>The idea that our minds are connected to our bodies and environments is called embodiment. Multiple neural, relational, experiential, and contextual processes converge in the brain – in ways unique to each young person – to produce complex skills and develop identity. Cognition and emotion have traditionally been regarded as separate. Research shows that they are inextricably linked. Early learning experiences, sense of self and motivation contribute in major ways to their development of self-control, self-direction and resilience.</p> <p>Adolescent brains develop higher order knowledge and skills through integrating social, emotional, academic, and life experiences. It is important to use holistic approaches, especially with young people with broad developmental ranges.</p>	<p>Use holistic approaches. Resist the temptation to focus on young people's weak areas:</p> <ul style="list-style-type: none"> • Focus on the whole person including their ecosystem. • Build on strengths. If youth have trouble regulating emotions, help them find opportunities to use their strengths (e.g., social or academic skills) that offer opportunities for gratification but also opportunities to be challenged or to stretch and fail.. • Name the different competencies youth bring into every experience. Help them see the ways each of them combine competencies to achieve goals when adapted and applied in particular contexts. <p>Encourage youth to work in teams on projects that require the full array of competencies (physical, social, emotional, etc.)</p>
<p>Continuum. Human development is a progression but not a linear one.</p>	<p>In reality, learning and development looks less like a straight line and more like an abstract or impressionistic painting. Children not only learn at different paces, but they also develop skills and master concepts in different orders. Learning and development are variable and progressive, moving from simplicity to greater complexity.</p>	<p>Think about your programming as a series of loops, rather than steps as you build experiences that center the main developmental tasks of adolescence – exploration and risk taking.</p> <ul style="list-style-type: none"> • Provide a range of starting points to accommodate different levels of readiness for the challenge.

Finding	Research Explanation	Practice Suggestions
	<p>Adolescents are creating new neural pathways to produce more complex skills and abilities – like abstract thinking - that cannot be expressed earlier in life. Progress along a continuum is driven by the right degree of challenge and productive failure.</p>	<ul style="list-style-type: none"> • Provide more than one opportunity to “loop back” to pick up a skill or master content presented earlier. <p>Watch your learners to make sure they are experiencing the right degree of challenge, across developmental outcomes.</p>
<p>Meaning Making. Meaning making ignites the desire to learn</p>	<p>Our brains are exquisitely, biologically designed to filter, organize and categorize incoming external stimuli (information) and integrate it with our own perceptions – to make meaning. Meaning making occurs when people reflect individually and collectively on and bring order to new knowledge and experiences in ways that connect the new with existing knowledge, often making adjustments. Hence it is always personalized.</p> <p>In adolescence, we emphasize the acquisition of complex concepts (e.g., math) by separating them from real life. But when the stretch is too great, adolescents tune out and may reject the experience.</p>	<p>Connect. Compare. Contextualize.</p> <ul style="list-style-type: none"> • Explain the competencies and concepts you hope young people will experience. Provide examples of their use in the real world. • Provide twice as much time as you think needed for them to reflect on their experiences, individually and as a group. • Ask them to think about the implications of what they have experienced or learned for themselves, families, and communities. • Push youth to think analytically and abstractly, beyond description to implications. Ask how they might apply what they learned.