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# Adolescence and the Reimagined High School - Scientific Perspectives on Development, Learning, and Civic Reasoning

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# Adolescence and the Reimagined High School - Scientific Perspectives on Development, Learning, and Civic Reasoning

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## Abstract

Adolescence is a developmental period of profound opportunity and vulnerability. It is marked by dramatic changes in brain network organization, emotional intensity, and social sensitivity, all of which shape how young people learn, relate, build a sense of self and envision their futures. Accumulating evidence from developmental psychology, affective neuroscience, and educational research shows that adolescents are uniquely disposed toward *transcendent thinking*: a disposition to grapple emotionally with abstract, systems-level, ethical, and personal implications of the concrete things they learn and experience. This emotionally powerful form of thinking undergirds civic development, resilience, and identity formation, while simultaneously supporting brain development, deep learning and psychosocial flourishing. Drawing on longitudinal neuroimaging studies, qualitative fieldwork, cross-disciplinary theory, and the Sciences of Learning and Development (SoLD), this report reviews scientific findings about adolescent development and teaching and highlights their implications for the reimagined high school. It argues that aligning high school education with adolescents' developmental needs—particularly by centering opportunities for civic reasoning and transcendent reflection, in the context of safe, strong relationships and meaningful learning opportunities—can promote not only deep scholarly learning but also civic purpose and individual and community wellbeing. Aligned with the science, the report lays out policy recommendations for systemic and structural redesign in the California context and highlights illustrative examples of promising work in the state.

# 1. Introduction

Adolescence is a developmental period of profound opportunity, during which young people increasingly seek to understand themselves, their relationships, and their place in a complex social world. Advances in developmental science, affective neuroscience, and the learning sciences are beginning to clarify the processes through which adolescents integrate emotion, cognition, and social experience to construct meaning, identity, and purpose. This report explains the important work of bringing these scientific perspectives to bear on the question of how high schools can better align with the developmental realities of adolescence. The report begins with a discussion of emerging empirical research, much of it conducted with diverse adolescents and teachers in California public schools, examining the neural, psychological, cognitive and social processes through which reflective meaning-making and civic reasoning develop and are supported during the secondary school years. Then, the report lays out the educational implications of this work, considering how the design of high schools, along with state and local policy initiatives, can either constrain or support these developmental processes. Together, these perspectives suggest that rethinking secondary education requires not only new instructional strategies but also a deeper alignment between the structures of schooling, the processes of teaching, and the developmental processes, capacities and needs that characterize adolescents and their learning.

## 2. Conceptual and Empirical Foundations of the Supporting Neurodevelopmental Work

The neuroscientific insights on adolescence advanced in the first half of this report emerge in part from a sustained program of research conducted over the past decade at the USC Center for Affective Neuroscience, Development, Learning, and Education (USC CANDLE). This work has been carried out primarily with adolescents enrolled in Los Angeles-area public secondary schools serving racially, linguistically, and socioeconomically diverse communities. California's policy environment, characterized by ambitious academic accountability systems alongside demographic and economic heterogeneity, provides a particularly consequential context in which to examine how adolescents'

developmental processes play out within educational contexts. Many of the findings summarized here are therefore grounded in the lived realities of young people navigating the educational, cultural, and institutional conditions of this state.

This body of research is anchored in a developmental systems perspective that understands learning not simply as the accumulation of discrete content and skills, or as the activation of isolated cognitive mechanisms, but as coordinated processes of skill building and meaning-making inherently connected to young people’s interpretations of their experiences and growing identities (Immordino-Yang, 2016; Immordino-Yang, Darling-Hammond, & Krone, 2019). From this vantage point, affect, cognition, culture, and identity are not separable inputs into learning (Nasir et al., 2020); they are mutually constitutive dimensions of development unfolding over time, supported and enacted through learning (Immordino-Yang et al., 2024; Rogoff et al., 2017). In this view, schools are therefore not merely vehicles for transmitting knowledge and building know-how. They are communal, developmental contexts that, through their design, directly shape how adolescents organize their values, goals, and sense of self, as well as their skills, knowledge and proclivities toward learning (Daniel et al., 2019; Hantzopoulos, 2016; Howard, 2021; Ladson-Billings, 2014; Nasir et al., 2020). We should be taking advantage of this reality by scaling designs of high school contexts that deepen meaning-making and foster purposeful participation of our youth.

At the theoretical core of this work is the proposition that the kinds of thinking in which adolescents dispositionally engage—particularly their reflective, socially grounded, systems-level and self-relevant forms of thinking—are associated with, and appear to contribute to, the developmental organization of large-scale neural systems over time (Gotlieb et al., 2024). We have used the term transcendent thinking to describe complex reflections that integrate personal experiences and conceptual understandings—imagined or real—with broader scholarly, ethical, cultural, or societal concerns (Immordino-Yang et al., 2024). Operationally, transcendent thinking is identified through systematic coding of adolescents’ spoken and written reflections for the degree to which they grapple to understand the big issues, lessons and concepts at stake in their daily experiences and learnings, an emotionally agentic process that also contributes to personal meaning, moral reasoning, social perspective-taking, relationships and identity (see Figure 1). Transcendent thinking is measurable and

reliably coded, and though additional work is ongoing, it is powerfully associated with neural activity patterns and longitudinal developmental outcomes (Ghaderi et al., 2025; Gotlieb et al., 2022) and can be supported by supportive relationships and learning opportunities (e.g., Riveros et al., 2023).

### Figure 1 - An Example of Transcendent Thinking

Here is an example of transcendent thinking from a California high school student's reflection on an English class assignment (Gonzalez, 2026):

*"The story that I wrote about was sad but also heartwarming because I was able to see how my grandma was able to complete her obstacles and grow from them. I was also able to see both sides of perspectives from both people since it was about my grandma and uncle. What I learned from writing this story about another person's situation is that even though the world throws obstacles at you it doesn't mean to give up or lose hope. It made me realize that even though obstacles are tough it's also a good thing that we have them in life because we can learn from them and know the world isn't perfect and that's okay. We all make mistakes but that is how we learn from them."*

In their reflection, this student goes beyond recounting the specific obstacles faced by their grandmother that are the concrete focus of the academic writing assignment. They describe the broader lesson they took from the opportunity to tell their grandmother's story, and extract a broader and personal value about maintaining hope and persisting, and moving through the world interpreting challenges as opportunities to learn.

Across a coordinated set of longitudinal, multimodal studies of California secondary students and teachers, USC CANDLE researchers integrated functional neuroimaging, behavioral assessments, narrative analysis, classroom studies, and follow-up measures of youth academic and psychosocial development. For the adolescent brain development studies, using functional MRI neuroimaging paradigms developed by the lab, diverse adolescents engaged with emotionally evocative narratives and complex social dilemmas, first in open-ended interviews, and then while neural activity was recorded. For the practitioner studies, teachers from across the southern California region engaged in in-depth interviews about their approaches, classroom observation studies, and authentic pedagogical

tasks during interviews and neuroimaging, such as grading their own students' assignments and providing feedback, or assessing videos of other teachers' classroom practices for the quality of learning happening. Both students and teachers were found to recruit combinations of distributed brain networks associated with internally directed cognition, attention, motivation, autobiographical reflection, and social reasoning—systems often described in the literature as components of the executive control, salience, and default mode brain networks (Immordino-Yang et al., 2012; Immordino-Yang & Knecht, 2020).

Importantly, the findings challenge the assumption that internally oriented, reflective emotional and cognitive processes involved in emotionally poignant and complex meaning-making and social processing distract from academic focus. Instead, variability in the coherence and coordination of the brains' large-scale networks during reflective tasks is prospectively associated with subsequent differences in adolescents' reported purpose, academic persistence, and psychosocial adjustment (Gotlieb et al., 2024). These neural findings are interpreted alongside qualitative analyses of adolescents' narrative reflections and teachers' pedagogical narratives and approaches (Gonzalez, 2026; Kundrak et al., 2025), and with data demonstrating the pedagogical power of teachers' personalized and developmental approaches to their work. The convergence of neural activation patterns, narrative complexity, and longitudinal outcomes provides multilevel evidence that reflective meaning-making constitutes a measurable and developmentally consequential dimension of adolescent growth that can be supported by highly effective teachers.

Crucially, this work situates neurobiological processes within developmental, cultural and institutional contexts: there is no default norm or standard to which adolescents' or teachers' brains are compared. Instead, these methods are designed to uncover dynamic longitudinal processes that vary across individuals, are agentially engaged by individuals in supportive contexts, and share common features and affordances. California's diverse educational landscape allows examination of how opportunity structures, school climates, and instructional practices shape the forms of thinking that students and teachers are invited—or constrained—to engage in. Development, in this account, is not reducible to brain activation patterns or to incremental psychological or academic achievement metrics; it is an emergent property of patterned engagement across social, emotional, cognitive, and

contextual systems over time (Immordino-Yang, Nasir, Cantor, & Yoshikawa, 2024; Immordino-Yang & Gotlieb, 2017).

Taken together, this body of research establishes three empirically grounded propositions that undergird many of the implications developed in the remainder of this report. First, consistent with decades of research in secondary contexts (Darling-Hammond, Alexander, & Hernandez, 2025), adolescents' reflective and socially grounded thinking is not ancillary to academic development; it is a central mechanism through which knowledge becomes purposeful, integrated with identity, and facilitative of long-term goals. Second, these processes have measurable neurobiological correlates and are prospectively associated with meaningful differences in well-being, engagement, persistence, and achievement. Third, educational environments, in ways directly shaped by state policy, play an active role in structuring teachers' and students' opportunities for such meaning-making (Daniel et al., 2019).

The considerations that follow are therefore anchored in convergent empirical evidence drawn from California's own students and teachers. They suggest that prevailing definitions of academic success may be productively expanded to incorporate developmentally grounded indicators of reflective engagement, identity formation, and scholarly purpose -- dimensions that the science of adolescent development indicates are integral to how young people learn, thrive, and prepare for adult participation in society. Of course, these indicators do not capture all of what is relevant in schools but instead capture dispositional factors that are embedded within students' structured opportunities to engage generatively and deeply with expansive and relevant scholarly content and skills.

### 3. Adolescence as a Critical Window

For too long, adolescence has been framed primarily in terms of deficits—immaturity, impulsivity, and poor judgment. Classic portrayals from neuroscience and psychology emphasized the delayed maturation of brain regions involved in executive control relative to faster maturation of subcortical emotion systems, painting adolescents as irrational and unstable “works in progress” (Steinberg, 2014). While clearly adolescents are still developing their abilities and skills, as well as their bodies and brains, these portrayals shaped cultural narratives and educational systems that underestimate young people's

cognitive and moral capacities, and that emphasize discipline and compliance rather than exploration, deep learning and development.

New research challenges this deficit model. Puberty does not merely usher in emotional turbulence but also a period of heightened neuroplasticity, social sensitivity, and abstract reasoning (Crone & Dahl, 2012; Blakemore & Mills, 2014; Foulkes & Blakemore, 2018). Adolescents' brains are reorganizing at a network level: connections among executive, reflective, and salience systems are pruned, strengthened, and reshaped in response to experience and cognitive and emotional opportunities. These changes scaffold new abilities to coordinate emotions with abstract thinking, fueling curiosity, idealism, and the search for identity and deep understanding (see Figure 2).



**Figure 2.** In a longitudinal 5-year study of diverse urban high school students, participants discussed complex social and personal issues, including the violence they had seen or heard about in their neighborhoods and what could be done to improve the situation, and their reactions to a set of 40 mini-documentaries about real teens' lives and accomplishments from around the world. Over the course of the day, all participating teens engaged in “transcendent thinking” as they explained how they felt and thought, offering advice and empathy, but then moving beyond to grapple with bigger lessons, curiosities and implications. Following the participants' brain development for the subsequent two years and psychosocial outcomes into young adulthood, the study found something remarkable: The more a teen had grappled with transcendent thinking during the initial interview, the more they increased gray matter volume, white-matter fiber tracks, and coordinated connectivity and “cross-talk” between important networks of their brain over the subsequent two years. And the more brain growth they showed over the two-year period, the stronger identity development they showed at around age 19 and the more they liked themselves, reported having satisfying relationships, and achieving at work or school in young adulthood (Immordino-Yang, 2025). These findings were independent of IQ, socio-economic

status, and other demographic factors.



The implication is that adolescents’ transcendent thinking is an important developmental process for neural and psychosocial development. This report explains how the disposition toward transcendent thinking, which is predicated on safety, relationships, and opportunities to think deeply

about important problems and material, can be supported by high school designs and developmentally oriented pedagogy.

This updated view reframes adolescence as a period of extraordinary developmental potential. Rather than a stage to be endured until the “real world” of adulthood begins, adolescence should be understood as a generative phase in which individuals develop the cognitive, emotional, and social capacities to become purposeful agents in their lives, communities and societies. Education systems, and especially high schools, must be designed with this potential at their core (Immordino-Yang, Nasir, Cantor, & Yoshikawa, 2024; Nasir et al., 2020).

## 4. Transcendent Thinking: The Engine of Adolescent Meaning-Making

### 4.1 Defining Transcendent Thinking

Across cultures and contexts, adolescents demonstrate a growing capacity for what has been termed *transcendent thinking*—the disposition to move beyond the immediate and concrete toward reflections on broader systems, ethical principles, and long-term implications. This form of reasoning integrates emotional salience with abstract cognition, enabling youth to grapple with important

questions, wrestling not simply with “what is” and “how things relate,” but with “why” and “what could or should be.”

For example, a recent study of Los Angeles teenagers asked participants why they think violence occurs in their communities, and what could be done about it. Some offered proximal explanations (e.g., “bad decisions,” “getting caught up in the moment”), while others situated events in broader cycles of history, culture, social expectation and emotional experiences (e.g., “everyone has a history,” “people come to believe what others say about their community”). Both forms of reasoning are valid, but the latter illustrates transcendent thinking—an orientation that connects immediate events to systemic causes and broader social and ethical considerations. The study found that the more youth tended to engage in transcendent explanations, the more their future brain development was protected from characteristic reductions in gray matter volume in the brain associated with the violence they had witnessed (Butler et al., 2018; Yang et al., 2025).

## 4.2 Neural Mechanisms

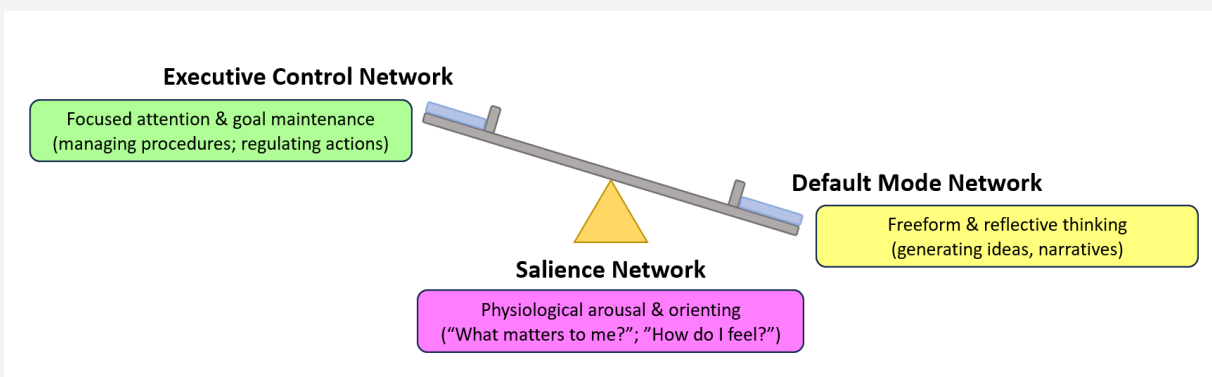
Transcendent thinking involves coordinated activity across many regions of the brain, among them three large-scale brain networks:

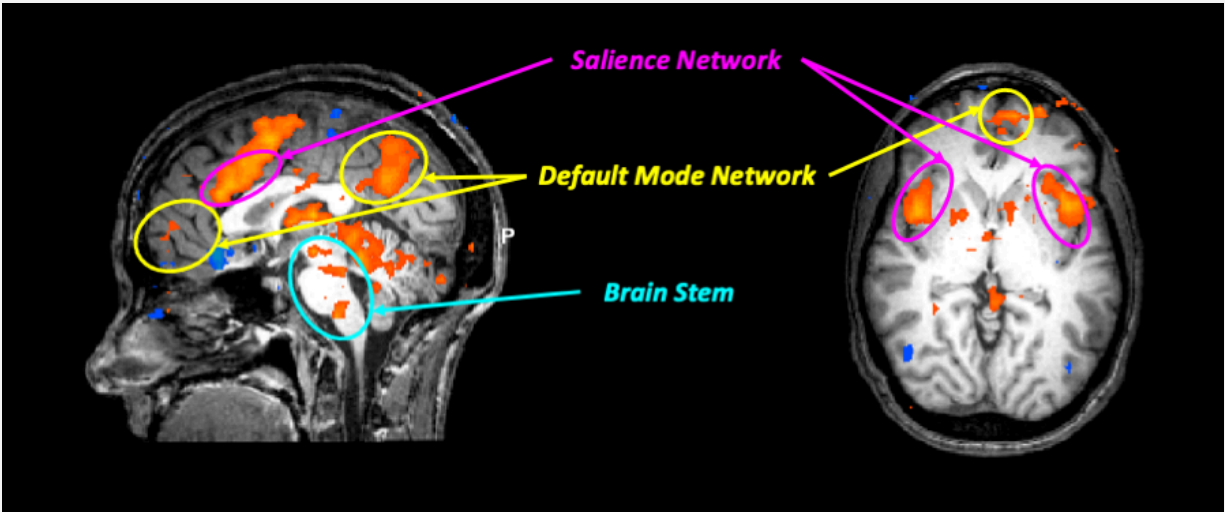
- **Executive Control Network (ECN):** supports focused, goal-directed cognition.
- **Default Mode Network (DMN):** supports reflection, narrative construction, moral reasoning, self-awareness and imagination, as well as memory.
- **Salience Network (SN):** monitors bodily and emotional signals, directing attention to what feels important or urgent.

During transcendent reflection, adolescents’ brains show a characteristic pattern: initial ECN activation, likely helping to focus attention, followed by reduced ECN activity and increased DMN activity, potentially coordinated in part by the SN. It is believed that this dynamic toggling between network activity states enables youth to integrate concrete details with abstract narratives and values, all in service of what seems emotionally pressing and relevant (see Figure 3). Over time, research suggests that repeated engagement in this neural choreography strengthens connectivity among these

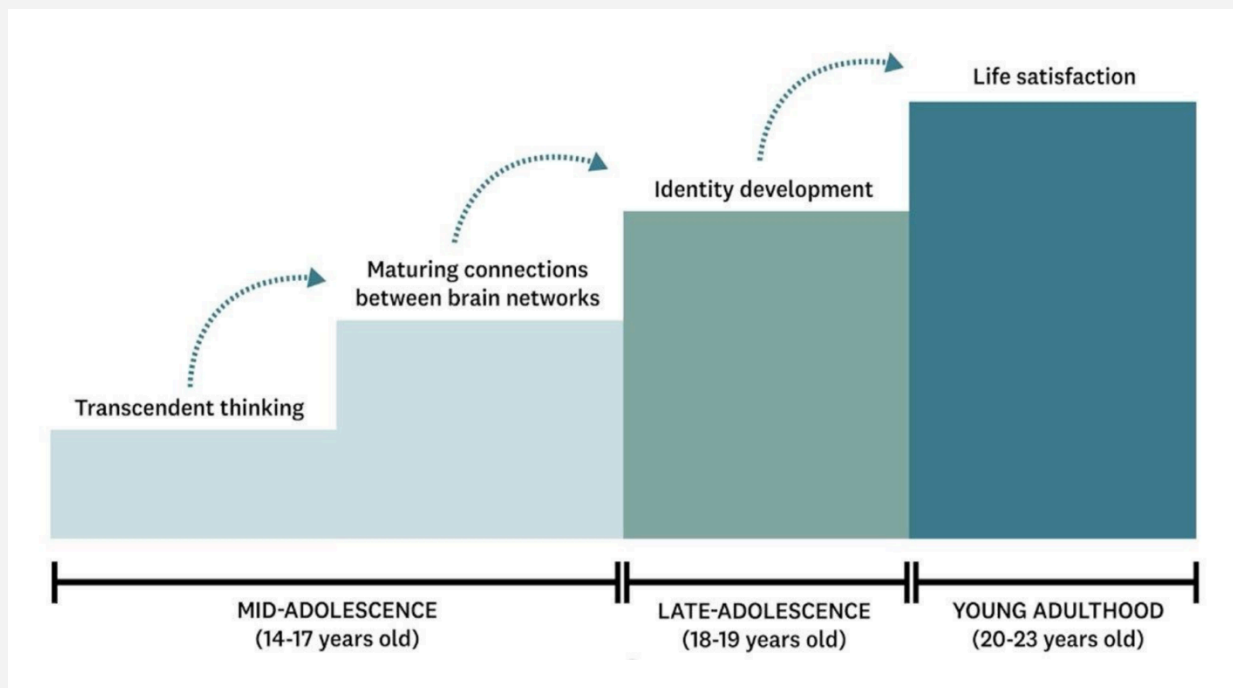
brain networks, fostering both cognitive flexibility and psychosocial growth (Gotlieb et al., 2024; see Figure 4). Transcendent thinking is understood as both a mental process, and, with habitual engagement in this process, it can become a disposition of mind that fuels adolescent development.

**Figure 3.** Schematic (top) and brain activation data (bottom) depicting three major networks of the brain that contribute to transcendent thinking. As the top panel illustrates, processes associated with the executive control network and the default mode network trade off in a coordinated way, like a see-saw, depending on what aspects of the situation are relevant to the individual (likely corresponding to activity in the salience network). (Brainstem activity in the bottom panel is associated with deep emotional engagement. These regions are essential for consciousness and physiological survival mechanisms, such as breathing and heartrate, and are coopted for thinking that feels powerful.) As adolescents engage in complex, emotionally engaged thinking, they activate and deactivate these networks in ways that the data suggest may contribute to healthy brain development over time. Note that the brain activation patterns depicted in the bottom panel of the figure likely reflect active coordination among these regions. Deactivations associated with the executive control network are not visible in this image. (Figure is from Immordino-Yang et al., 2024; data [bottom panel] are from Immordino-Yang et al., 2009).





**Figure 4.** Schematic depicting a developmental progression in which teens who engaged in more transcendent thinking in an interview about complex social stories and issues at the start of the study in turn showed more brain development between the first and the second study visit, two years later. In the next analysis, teens who showed more brain growth in turn described more complex identity development at around age 19, reporting that they spend time thinking about the adult they want to become, and what they believe in and stand for, and that they think about such things with others whom they know well and trust. Identity development, in turn, predicted various indicators of wellbeing and life satisfaction in participants’ early 20’s, five years after their initial participation in the study. Notably, teens’ transcendent thinking at the start of the study did not directly predict outcomes in young adulthood. Instead, youth had to pass through each developmental stage, doing the work of growing themselves and their brains as they progressed from teen to young adult (see also Immordino-Yang, 2025; data are from Gotlieb et al., 2024).



## 4.3 Developmental Implications

Longitudinal studies demonstrate that adolescents who engage more in transcendent thinking show:

- Greater increases in white matter integrity and gray matter volume in the brain.
- Stronger identity development in late adolescence, including clarity of values and life purpose.
- Higher life satisfaction and relationship quality in young adulthood.
- Neural resilience to community violence exposure, with protective effects against cortical thinning.

Taken together, these findings suggest that transcendent thinking is a developmental mechanism with enduring benefits—like exercise for the brain. It is, in short, one of the most important “muscles” adolescents can exercise, and deeply motivating to them.

# 5. Civic Reasoning: Transcendent Thinking in Practice

## 5.1 Linking Transcendent Thinking and Civic Life

Civic reasoning—the capacity to weigh evidence, consider multiple perspectives, and deliberate about social and ethical issues—emerges from adolescents’ transcendent thinking. It represents a critical developmental affordance for community and democratic life. Unlike civil behavior (rules of politeness and compliance), civic reasoning requires meaningful engagement with values, identity, diverse perspectives, and questions of justice. Of course, the content of transcendent thinking, like any thinking, will reflect the views, experiences, knowledge, and beliefs of the thinker. For this reason, transcendent thinking is not necessarily prosocial. It could be used in antisocial ways that harm others (for instance, when ideological beliefs advertently or inadvertently undermine others’ autonomy or wellbeing), or even that harm the thinkers themselves (for instance, when transcendent thinking devolves into rumination, as the active toggling between reflective and action-oriented, “here and now” thinking is stymied, and the thinker becomes caught in a depressive “internally focused” state antithetical to civic engagement). Two implications for education here are (1) that the benefits from transcendent thinking in the civic context likely are produced not simply by reflective thinking itself but

also by actively moving between more concrete, “dig in and do” and more abstract, “step back and think” modes of awareness, and (2) that the content of transcendent thinking matters. Adolescents need curated opportunities to engage with big ideas as well as with here-and-now activity, within the course of their scholarly and civic activities.

## 5.2 Empirical Evidence

Interviews with adolescents reveal that civic reasoning is often experienced as emotionally motivating and personally meaningful. Students describe working harder in math, for example, not simply to pass tests, but to “better the world” or to “help classmates understand” (Immordino-Yang et al., 2024). In such cases, academic learning becomes infused with civic purpose, reinforcing both mastery and identity (Lee et al., 2021). Evidence suggests that such ways of thinking can be supported by conducive pedagogical practices, teachers who socialize such values in the classroom, and school settings designed to promote student autonomy and belonging (Darling-Hammond et al., 2020; Hantzopoulos, 2016; Patall & Zambrano, 2019; Spencer et al., 2020).

Neuroimaging evidence shows that civic reasoning activates brain regions involved in social emotion, narrative integration, and self-awareness, and that such thinking predicts future development in these networks. Adolescents’ proclivity for civic reasoning, therefore, is not only a psychological achievement but appears also to be a driver of neurobiological development that supports wellbeing.

## 5.3 Resilience and Equity

Importantly, civic reasoning appears particularly powerful for youth facing adversity. For adolescents in high-crime urban neighborhoods, transcendent reflections about community violence predicted protective brain development compared to peers who offered only concrete interpretations. These findings underscore that educational opportunities to practice civic reasoning may be essential not only for democracy but also for equity and resilience (Hope & Spencer, 2017). Transcendent thinking is an essential capacity for engaging with complex issues and their implications, and evidence from schools suggests that youth need support and safety to deeply immerse themselves in such patterns of thinking. School designs, teachers’ practices, and curricula that develop students’ capacities

for grappling with multiple perspectives on complex and fraught issues, tolerance for uncertainty and complexity, and dispositions for engagement with diverse positions, histories, values, identities and experiences, are therefore a core tenet of secondary educational reform. Youth naturally engage in transcendent reflections on their and others' identities, values, and beliefs. In a democracy, the role of schooling is to support them in building out the skills and evidence bases to engage these reflections in informed, responsible, ethical and beneficent ways so that they can rely on these habits of mind in their civic lives as adults (Lee et al., 2024).

## 6. The Broader Scholarship of Learning and Development: Conditions for Thriving

While transcendent thinking provides a focal lens, it unfolds within broader developmental conditions articulated by the Science of Learning and Development (SoLD). Three interrelated principles warrant particular attention in secondary education, as described below.

### 6.1 Development Is Shaped by Relationships

Adolescents' heightened social sensitivity renders relationships central to development. Trusting, attuned relationships with adults and peers support appropriate intellectual and emotional risk-taking, buffer stress responses, and scaffold identity formation (Gunnar, 2017; Immordino-Yang, Darling-Hammond, & Krone, 2019; Levy et al., 2016; Riveros et al., 2023). Conversely, relational disruption or chronic social threat constrains reflective capacity and narrows cognitive flexibility, pushing the brain into a threatened state. Neurobiological research demonstrates that supportive relational contexts modulate stress reactivity systems and enhance prefrontal integration. Thus, relationships are not merely contextual supports<sup>[OBJ:OBJ]</sup>.

Educational environments organized around transient, impersonal interactions undermine this principle. Sustained advisory structures, mentorship, and collaborative learning communities align more closely with adolescents' relational needs. It is also relevant that adolescents are hungry for the kinds of social environments and communities that provide opportunities for meaningful social growth

and connection. When schools fail to provide such opportunities, youth may find these relationships in other settings, some of which can be beneficial and enriching, such as community, religious and sports organizations and after-school activities, and others of which can lead them into dangerous situations and activities, such as street gangs (Bundick et al., 2010; Lenzi et al., 2015). As the world and our schools adapt to the impacts of artificial intelligence technologies, it is crucial to keep in focus to what degree AI is undermining or supporting authentic human relationships as the platform for learning and healthy development that decades of research so plainly demonstrate (Odgers et al., 2020).

## 6.2 Psychological and Physical Safety as Preconditions for Learning

The brain's capacity for integrative reflection depends on freedom from chronic threat (Immordino-Yang et al., 2019). Prolonged exposure to unpredictability, discrimination, or humiliation activates stress systems that prioritize immediate survival over abstract reasoning. Psychological safety—characterized by predictability, inclusion, high expectations and respect—enables the brain network dynamics implicated in transcendent thinking to emerge (Spencer et al., 2020). Referencing the brain networks mentioned above, constant external vigilance is thought to keep the executive control network engaged as the salience network is reacting to signals that the brain must continue to look outward in the world to maintain safety, rather than the timely quieting of the executive control network in favor of the default mode network to look inward, reflect, and make deeper meaning out of human experience.

This principle extends beyond individual classrooms to encompass school-wide climates. Restorative approaches to discipline, culturally responsive pedagogy, trauma-informed practices, and wrap-around services for the whole student create the conditions under which adolescents can engage in the kind of meaning-making that supports healthy development (Darling-Hammond, S., 2023; Hantzopoulos, 2016; Howard, 2021; Ladson-Billings, 2014). It is important to note here that psychological safety is not the same as being free from psychological discomfort or tension. However, students benefit from a sense of trust in their relationships with educators and peers, and within their larger school environment when required to persist in the face of content, discussions, tasks, and situations that challenge their sense of psychological comfort.

## 6.3 Individual Developmental Trajectories

Adolescents vary in timing of pubertal development, cultural context, prior experiences, and neurocognitive profiles. This does not imply that youth fall into predetermined and essentialist categories. Instead, this fact adjures systems to accommodate variation and youth autonomy, building systems with multiple pathways to achievement and genuine opportunities for personally meaningful engagement (Ladson-Billings, 2014; Nasir et al., 2021; Rogoff et al., 2017). One-size-fits-all curriculum, undifferentiated teaching, and a regime dominated by standardized assessments obscure this variability and fail to support many youth. Research in developmental neuroscience underscores that learning trajectories are nonlinear and individualized (Fischer & Bidell, 2006).

Educational structures that allow for multiple pathways to mastery, varied forms of demonstration, and differentiated supports – all in the context of meaningful human relationships and emotional and physical safety – better reflect the complex reality of human development. Supporting and attending to individuality is not merely an equity imperative; it is developmentally appropriate practice that benefits all youth, and requires deep disciplinary and professional knowledge on the part of teachers and staff (Darling-Hammond et al., 2025).

## 7. Implications for High School Design

The convergence of research reviewed here suggests that, for the healthy development of adolescents and the maintenance of our democratic ways of life, secondary education must provide structured opportunities for:

- Deep, integrative learning that connects disciplinary knowledge to systemic and ethical contexts, even when those contexts are historically fraught, politicized and inequitable;
- Agency in shaping learning pathways, and authentic choices in pursuing areas of deeper learning;
- Identity exploration and authorship, and support for all youth to engage authentically in such growth under the care and support of trusted and knowledgeable adults;

- Sustained inquiry into meaningful questions and engagement in increasingly complex disciplinary material;
- Perspective-taking and civic discourse within shared norms of respectful interactions;
- Embedded social-emotional learning;
- Strong, developmentally attuned relationships;
- Psychologically safe and inclusive environments;
- Shared learning goals along with flexible, individualized trajectories toward competence.

These are not peripheral enhancements. They are direct implications of how adolescent brains and identities develop. Collectively, these affordances suggest that reimaged high schools should structure learning experiences around meaning-making, relationships, safety, and individual agency and belonging, ensuring that the developmental strengths of adolescence are fully leveraged for academic, civic, and personal growth (see also Figure 5). These changes can serve to strengthen the emotional investment many students have toward the learning process itself, caring about big ideas and collaborating to solve complex issues, and lessening fixation on the externalized outcomes of schooling, such as test scores and grades. Having emotions about ideas (curiosity, wonder, moral tension, etc.) is the essence of transcendent thinking, which is fuel for healthy development and active civic participation in our young people.

**Figure 5.** New data from a multimodal study of 40 urban public secondary teachers from the Los Angeles region demonstrates the importance of developmentally informed perspectives. Participating teachers were from schools serving low-SES urban communities and were nominated for excellence by their administrators. These teachers came to the laboratory, where they were interviewed about their approaches. An independent team observed and rated their classroom teaching, using an adaptation of the TRU framework (Schoenfeld & the Teaching for Robust Understanding Project, 2016)—a framework that is not prescriptive but instead aims to capture the extent to which teachers’ actions and structural supports provide opportunities for all

students to develop scholarly identities and habits of mind, engage in productive struggle, and deepen their understandings. Qualitative interview analysis yielded four characteristic “pedagogical narratives”, which were ordered according to how thoroughly teachers integrated considerations of students’ personal and intellectual development into their justifications for their teaching practices, from “transformative” to “responsive,” “transactional” and “gatekeeping”. Teachers whose pedagogical practices were rated highest (i.e., “transformative”) shared narratives that center their students’ subjective experiences and focus on the affordances of these experiences, in context, for students’ learning beyond just skill mastery. These teachers described students’ feelings about self and academic content as intertwined and made explicit that they did not expect uniformity across students, but that they supported individual variability, and wanted to help their students “find themselves” in the work. By contrast, teachers with the least developmentally oriented narratives (i.e., “gatekeeping”), positioned themselves between their students and the content, often limiting access to academic tasks and materials in order to protect students from failure. These teachers described feeling hyperaware that their students, whom they care deeply about, are being judged against standards that are inappropriate. Such teachers, though well meaning, imposed a deficit orientation, describing their students’ capabilities in incremental, finite frames. Perhaps unsurprisingly, but importantly nonetheless, the more developmentally rich a teacher’s narrative was about their students’ learning, the better the teachers’ practices were rated in the classroom observation, irrespective of years of teaching experience. In addition, it was notable that teachers with the least developmental perspectives, “gatekeepers” who focused mainly on doling out work that would enable youth to be incrementally successful, often described feeling overwhelmed, pressed for time, hopeless and worried for their students. The findings suggest that understanding the coordinated nature of adolescents’ personal and intellectual development and academic learning improves teachers’ practice and lessens their stress, consistent with the reforms we advocate in this report. See Kundrak et al, under review [https://osf.io/preprints/osf/95d2e\\_v5](https://osf.io/preprints/osf/95d2e_v5)

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For an analysis of brain activity in these teachers as the engaged in their work, grading students’ assignments and providing open-ended feedback, see Figure 7.

## 7.1 The Mismatch Between Adolescent Needs and Secondary School Designs

Across the United States, districts and states are working to redesign secondary schools, as there is growing recognition that the factory model inherited from 100 years ago was not designed to provide the kind of learning needed and desired by adolescents or the relationships young people need to feel safe, cared for, and engaged. That model, adapted from Henry Ford’s then-popular assembly line for mass production and applied to schools using Frederick Taylor’s scientific management principles (Gabor, 2018; Stoller, 2015), was designed to put young people on a conveyor belt and move them from one teacher to the next, in 45-minute increments, to be stamped with separate lessons seven or eight times a day, with a hallway locker as their home base. As individual workers on the assembly line, teachers are typically expected to see 150 to 200 students daily as they pass through the classroom. Students who need additional resources or personal advice may need to wait weeks to see a counselor with a caseload of 500.

In these generally large, impersonal settings, students have little opportunity to become well known over a sustained period of time by adults who can consider them as whole people or as developing intellects. As a result, these institutions typically focus more on the control of behavior than the development of community. While these factory model designs may have worked for the purposes they were asked to serve a century ago, they do not meet most of our young people’s needs today, or the needs of our democracy. In one nationwide survey, for example, only 29% of middle and high school students reported that they attended school in a caring environment and fewer than half felt they were learning important competencies for their adult lives (Benson, 2006).

In the midst of rapid social changes that require the development of more purposeful self-managed learning and use of higher order skills, most high schoolers in traditional settings experience a curriculum that transmits information in disconnected bytes as initially defined by a small group of educators appointed by the National Education Association in 1892. The “Committee of Ten” defined the expectations for course taking in each subject area that still define high schools in most states today. These subjects are often taught abstractly and in siloes, as material to be memorized without application to real world concerns in ways that stimulate inquiry and problem-solving.

Conventional high schools too often prioritize a standardized version of this transmission curriculum which is evaluated through multiple choice and short answer testing that seeks simple right answers. In the area of civics, this includes teaching facts about government systems over creating learning experiences to practice democracy and build civic habits in secondary schools (Winthrop, 2020, Knecht, 2017). Too many of our schools are also focused on behavioral compliance managed through externally determined rules rather than internally developed community that would support the development of transcendent thinking and civic reasoning.

These emphases can feel disconnected from adolescents' developmental drives for agency, belonging, and contribution. The result is disengagement, alienation, and a loss of opportunities to harness adolescents' visionary potential. It may not be surprising, then, that a recent Yale survey of over 25,000 high school students found that 75% had largely negative feelings about their school experience, with the most frequent adjectives being "stressed," "tired," and "bored" (Moeller et al., 2020).

## 8. New Designs for Secondary Schooling

Fortunately, as many contemporary secondary schools struggle to meet the academic, social, and emotional needs of students, newly emerging models have informed a substantial body of research that describes the key features associated with much more productive experiences and stronger outcomes for students. Over the past 30 years, hundreds of redesigned secondary schools have demonstrated that it is possible to enable much greater levels of success for young people, including those who have been historically left out and pushed out of opportunities to learn. Some urban districts like Chicago, Oakland and New York City launched small schools initiatives in the 1990s; pilot schools with new designs were developed in Boston and Los Angeles; and school networks supporting distinctive models—such as Big Picture Learning, the Linked Learning Alliance, New Tech High Network, and the Internationals High schools—have emerged to work with districts on redesign (Hernández et al., 2019).

These models support both small schools and small learning communities within big school buildings. These offer project-based learning that tackles real-world problems, featuring internships in local workplaces and community organizations, projects that engage students in studying and

impacting community problems by being civically engaged, as well as dual credit courses with local universities. They are organized into relationally-supportive teaching teams that are accountable for shared groups of students and plan around their needs, while also supporting students with advisory systems that ensure they are well known and have an adult advocate who can help them with any concerns or issues.

Recent studies of these models and other successful secondary schools demonstrate that sustaining student-centered, equity-focused approaches to deeper learning also requires coherent instructional systems that align curriculum, assessments, professional learning, and leadership structures toward common goals focused on deep, authentic learning grounded in strong relationships between and among educators, students, and families (Huberman et al., 2014; Huberman et al., 2016; Lee et al., 1993, Forman et al., 2018, Forman et al., 2020). This coherence is a key organizing condition that allows relationship-centered, inquiry-driven designs to take hold and endure. These studies also highlight the importance of organizational designs that support continuous improvement, strong professional cultures, and shared beliefs about how to enable students' capacities for transcendent thinking, civic reasoning, and social responsibility. Grounded in developmental science and empirical research, school redesign incorporating these features offers a powerful pathway to more equitable, inclusive, and developmentally aligned learning environments (Cantor et al., 2021; Hernández & Darling-Hammond, 2024).

## 9. Developmentally Aligned Practices

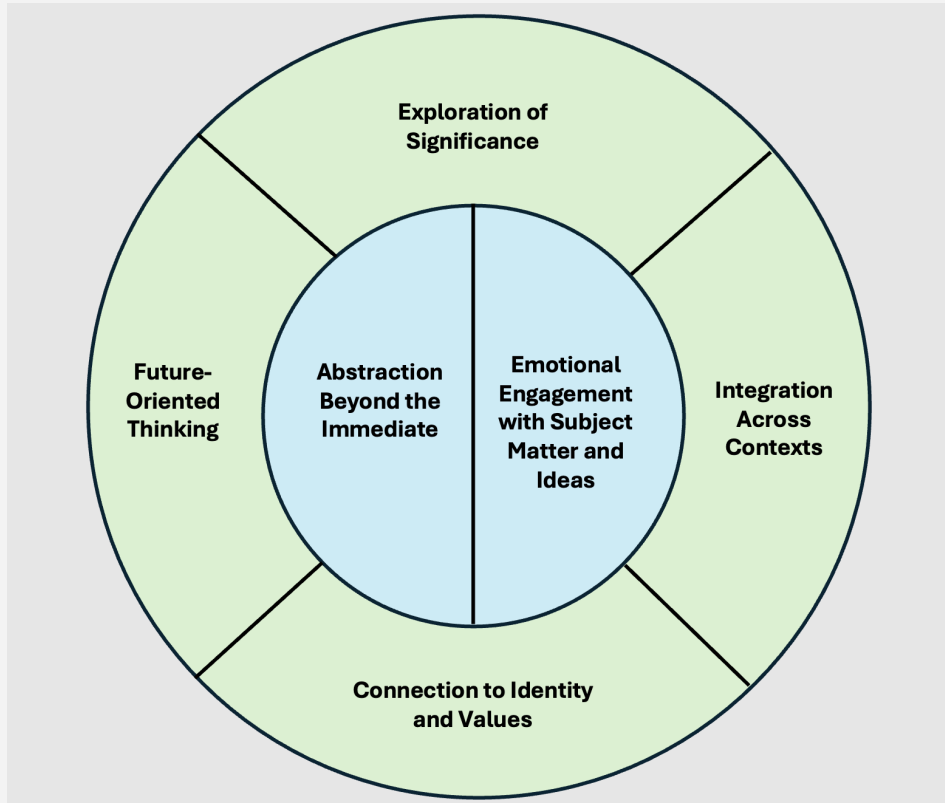
Research suggests three key elements for aligning high schools with adolescents' developmental affordances:

- **Relational Structures and Practices** that enable students to be personally and intellectually well-known and supported by adults and peers in communities of caring and high expectations; these practices, including restorative approaches, integrate accountability with reflection on broader community implications, engaging both concrete explorations of evidence, facts and happenings, and transcendent reasoning about the broader implications and the dynamics of complex disciplinary content and societal systems.

- **Authentic, Inquiry-Based Curriculum, Instruction and Assessment** that encourages and integrates sustained inquiry, reflection, and authentic demonstration of understanding connected to social-emotional learning, developing agency, purpose, and perseverance; these approaches value depth of learning over breadth while also supporting students to engage with complex content through performance-based curricular tasks.
- **Community Connections and Civic Engagement:** Experiential engagement with community organizations and issues, connecting content, skills, and opportunities to practice democracy in school with real-world concerns and pressing social issues; in this way, learning becomes relevant and school is made more meaningful while fostering civic reasoning and preparing students for college, careers, and democratic participation.

### Figure 6. Teaching to Promote Transcendent Thinking in Secondary Schools

Typical high school teachers are not trained or provided professional development to promote their students' transcendent thinking. USC's Center for Affective Neuroscience, Developmental, Learning and Education (USC CANDLE) is partnering with ASU's Center for Whole Child Education to build a framework and set of tools for educators. This initiative is supporting scores of educators to redesign their curriculum, teaching practices, and assessments after learning about the neuroscience of adolescent development. From their experiences, the USC CANDLE and ASU teams are building new tools and resources that will be freely available to all educators. Below is an early example of a chart that offers simplified guidance for teachers as they plan their curriculum and engage their students in transcendent thinking.



| <b>Foundational Elements of Transcendent Thinking</b>     |  |
|---|--|
| <i>Abstraction Beyond the Immediate</i>                   | Students make meaning by moving from specific facts, texts, problems, or experiences to broader principles, patterns, systems, or concepts.      |
| <i>Emotional Engagement with Subject Matter and Ideas</i> | Students' thinking is motivated and sustained by emotion (e.g., curiosity, concern, wonder, moral tension), signaling that the learning matters. |
| <b>Possible Expressions of Foundational Elements</b>      |  |
| <i>Exploration of Significance</i>                        | Students interpret significance, implications, or lessons, asking "why this matters" as well as "what it is."                                    |
| <i>Integration Across Contexts</i>                        | Students connect ideas and information across disciplines, time periods, situations, or perspectives rather than treating knowledge as isolated. |
| <i>Connection to Identity and Values</i>                  | Students relate what they are learning to who they are, what they care about, and what they believe is important or right.                       |
| <i>Future-Oriented Thinking</i>                           | Students consider consequences, possibilities, responsibilities, or imagined futures for themselves or the broader world.                        |

## 9.1 Relational Structures and Practices

Positive developmental relationships support student learning and development in multiple ways (Daniel et al., 2019). Research reveals that relationship-centered schools:

- are rich in protective factors that help reduce anxiety and stress among students;
- support social and emotional development, which can bolster student engagement, social competence, motivation, healthy attachment, and a sense of school connectedness;
- allow students to explore new learning experiences, take intellectual risks, persist through challenges, and develop their multifaceted identities; and
- pave the way for improvements in student outcomes such as academic achievement and graduation rates (Darling-Hammond et al., 2019).

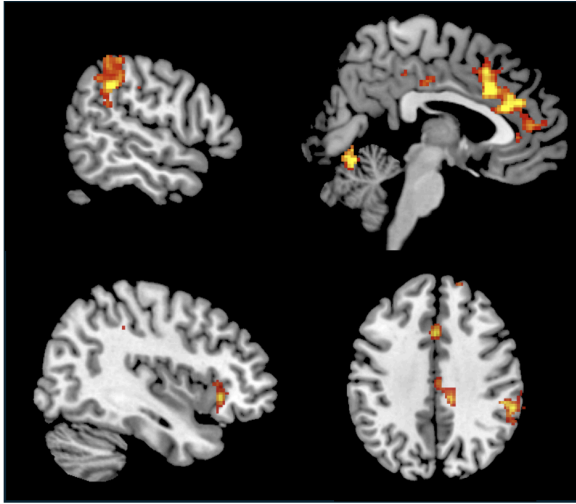
Beyond the important impact relationships can have on individual students, attention to relationship-building in schools can create a ripple effect that contributes to the development of a positive school culture and climate.

Cultivating positive relationships is especially important in adolescence, when youth are exploring their identities and have a growing need for connection and belonging. It is also especially crucial for adolescents experiencing the effects of poverty, trauma, racism, and other forms of discrimination, which can affect their relationship-building with both peers and school adults and trigger stereotype threat that acts like a form of toxic stress that impedes thinking and performance (Steele, 2011).

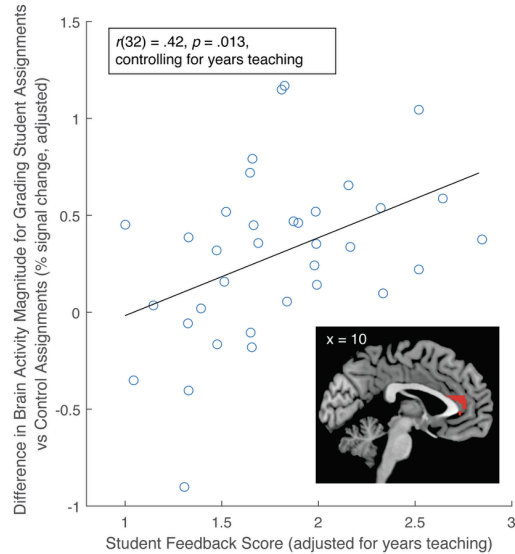
While research indicates that relationships matter for learning, conventional secondary schools that assign as many as 200 students to each teacher are organized in ways that make it difficult for adults to know them well. When teachers know their students well, both personally and intellectually, they think more deeply about the students' work and about the feedback they give (see also Figure 7).

**Figure 7.** New data from a multimodal study of 40 urban public secondary teachers from the Los Angeles region used fMRI neuroimaging to test the hypothesis that for the most effective secondary teachers, even the routine act of grading students' assignments is deeply social and emotional work. Participating teachers graded their own students' formative assignments while undergoing fMRI, and then provided open-ended verbal feedback, of the sort that would be appropriate in a teacher-student conference, to their individual students. Neuroimaging data revealed significantly increased activation in brain regions involved in attention, motivation, social processing and emotion while teachers graded their own students' assignments, compared with equivalent assignments teachers were told were "from the internet," despite assigning similar scores to both sets. (In actuality, researchers composed these control assignments to be substantively equivalent to their actual students' work.) What is more, the quality of teachers' individualized student feedback, measured as the degree to which teachers integrated personalized developmental considerations and addressed each student's developing dispositions of mind, moderated this neural effect. In other words, teachers whose feedback encouraged their students to "develop intellectual courage," "learn to think more things," or to carefully consider and "value" others' perspectives, showed a bigger increase in neural activity when grading their own students compared to students they do not know. (Conversely, teachers whose feedback focused on students' concrete behaviors, such as praise for students' good work habits or consternation about incomplete assignments, showed less difference in brain activity between the two conditions.) The findings demonstrate that teachers' depth of thinking about their students' development is consequential, influencing even routine aspects of their work, like grading assignments. Naturally, teachers' relationships with their students are key to their depth of thinking about their students' development. Especially in an AI age, the findings renew appreciation for the most effective teachers' social expertise and effort, and highlight the need for reforms in teacher support and professional development (from Kundrak et al., in preparation).

a. Teachers showed increased brain activation in social-affective and attention-related regions when grading their own student's work versus equivalent work from unknown students, despite grading the two assignments similarly.



b. The neural effect was bigger for teachers whose open-ended feedback to their students was more developmentally oriented and holistic.



Additional interview data from participating teachers, and independently assessed classroom observations, revealed that teachers with the most developmentally oriented approaches to their work, as described in their laboratory interviews, also demonstrated the highest quality practices (Kundrak et al., 2025). Teachers with the least developmentally oriented approaches also reported feeling the most stress and worry for their students. Termed “gatekeepers,” these teachers cared deeply for their students, but framed their work as protecting youth from possible failure by doling out discrete and highly curated opportunities for academic success. Taken together with the neural findings, these data suggest that a developmental orientation toward secondary teaching is both more effective for students, and, ultimately, less stress inducing for teachers.

## 9.2 Small learning communities

Small learning communities are a primary mechanism for promoting personalized relationships in schools. Over the past few decades, educational research has found that, all else being equal, small learning communities of 300–500 students—whether small schools or smaller units within large schools—tend to produce significantly better results for secondary students, including better attendance, greater participation in extracurricular activities, stronger academic achievement, higher grades, fewer failed courses, fewer behavioral incidents, less violence and vandalism, lower dropout rates, and higher graduation rates (Darling-Hammond et al., 2006).

Large schools may use “houses” or “academies” to create small learning communities: cohorts of students and teachers that form unique identities and intentional communities. These learning communities are designed for staff and students to work together in smaller and closer-knit units, which create the conditions under which students can be known well.

In addition, grade level **teaching teams** that share a cohort of students (typically 80-120) can personalize instruction for those students by planning around their needs and interests, developing interdisciplinary units and projects, and, sometimes, following the students from one grade to the next. This kind of looping allows for greater continuity, enabling teachers to get to know their students and how they learn better. It also provides students with adults whom they come to know and trust, acting as an anchor during more challenging moments or periods of their high school experiences. These consistent teaming structures – along with advisory systems (see below) -- also allow students’ families to build meaningful relationships with school staff.

Structures like **block scheduling** – which allows for 90-minute periods that can support deeper and more experiential learning – allow teachers to work with half as many students each semester. In schools with block scheduling, educators may have, for example, three 90-minute classes each day instead of six 45-minute class periods. This structure can foster consistent interactions and relationship-building during classroom instruction, especially when courses continue for a full year and teachers use the longer class periods to implement teaching strategies that support inquiry, help students obtain directed practice, personalize instruction, and create space for more student collaboration, choice, and agency.

**Advisory systems** provide each student with a home base, a caring community, and an adult liaison between school, student, and home. They are much more than the traditional high school homeroom structure. In effective advisory systems, each advisor serves as an advocate for a small group of students (usually 15–20), often over 2 to 4 years. Ideally, this advisor is also one of the student’s teachers or counselors, so advisory serves as an extension of an existing relationship.

The advisor facilitates an advisory class that meets regularly, promotes a sense of community among peers, and presents opportunities for students to receive support on academic and nonacademic issues. Successful advisories provide a structured space for checking in on home and school conditions, building community, exploring college and career opportunities, and teaching strategies such as social-emotional learning skills and conflict resolution. They also provide a primary adult point of contact, who connects closely with families or guardians and acts as an advocate for every student. Many studies showing the positive impact of redesigned secondary schools note that advisories are a key strategy for personalization and improving student outcomes (Darling-Hammond et al., 2025).

Relationship-centered schools do not solely emphasize individual attachments. They also systematically place care at the center of the school’s culture and integrate structures that enable inclusion and create a sense of social, emotional, and psychological safety for all students.

This involves explicit means to **build community**, in which expectations for student behavior are framed around **shared values**, which are rooted in the right of every student to feel safe and be included, rather than long lists of rules and punishments. These values, which focus on respect and consideration for others, are developed and discussed in concert with students, who learn to think about the greater good and their responsibility for protecting the community, becoming advocates for the norms and for one another. Strategies like community circles, in which students regularly share their experiences and thoughts with one another, both in the context of their advisory and in content classes, create community bonds that form and maintain relationships that protect a positive school climate.

Explicitly teaching **social, emotional, and cognitive skills** helps demystify the growth process for young people and allows them to cultivate agency in their personal development. It has also been

shown to improve student achievement (Greenberg, 2023; Ha et al., 2025) Social and emotional learning can be developed in advisory and via integrated approaches across the academic curriculum through practices such as helping young people become aware of their own and others' feelings and perspectives, develop empathy, and learn skills of collaboration and conflict resolution.

Opportunities to teach and practice these skills schoolwide enable restorative practices that are supported by establishing productive processes for managing disagreements, followed by training and supporting staff and students to consistently apply these approaches to resolve disputes, rather than excluding students through suspensions. In restorative schools, the goal is to support students daily through community building, explicit teaching of problem-solving and empathy, and methods that repair harm and enable students to make amends (Gregory et al., 2016; Losen, 2015). A recent large-scale study found that the more students engage in such practices, the more their academic achievement and mental health improve, and the less violence, bullying, or other anti-social behavior occur in schools (Darling-Hammond, S., 2023). Not incidentally, these processes develop and strengthen transcendent thinking and a moral / ethical base for behavior.

## 10. Authentic, Inquiry-Based Curriculum, Instruction and Assessment

We know from research in the learning sciences that the most powerful mode of learning for human beings is generated by inquiry that awakens the brain to search for information connected to personally meaningful questions (National Academies of Sciences, Engineering, and Medicine [NASEM], 2018). An **inquiry-oriented curriculum** aimed at transferable learning—that is, learning that can be tapped and used in other settings—engages students and challenges them to understand concepts deeply, find and integrate information, assemble evidence, weigh ideas, and develop skills of analysis and expression. Further, we know that students learn at different paces and in different ways that build on their prior experiences and connect to their interests, modes of processing and expression, and cultural contexts.

Rather than just marching through topics in the curriculum, effectively redesigned schools pay attention to the most important part of the equation: the students themselves and their ability to make meaning of information, experience, and the world they live in so that they can use knowledge for their own purposes. Especially at the secondary level, students come to school with a wealth of knowledge, skills, habits, and views about the world and their role in it. In developmentally grounded secondary schools, intellectually challenging work is focused on preparing all students to meet the demands of college and careers by addressing problems that are meaningful to them. Curriculum focuses on essential questions that organize learning around big ideas, and on other essential competencies, including critical thinking and problem-solving, collaboration, effective communication, self-directed learning, and development of academic mindsets. Students engage in inquiry in all classes, producing significant pieces of analytic work, including research papers, projects, models, and designs, that are aimed at in-depth understanding.

In addition to rethinking curriculum and pedagogy, redesigned schools take more meaningful approaches to assessment that begin with clarity about what students should know and be able to do when they graduate and continue by creating opportunities for students to develop, refine, and exhibit those skills in authentic ways. Performance assessments allow students to demonstrate their knowledge more fully by directly exhibiting a skill, reporting on an investigation, developing a product, or performing an activity. Research shows that students who regularly engage in such assessments do as well on traditional standardized tests and better on tests of analytic and performance ability than other similar students (Darling-Hammond & Adamson, 2014). They are also better prepared for college (Fine & Pryiomka, 2020). Teachers who regularly use and score such assessments learn more about how their students understand the material and have developed applied skills, as well as about the standards embedded in the assessments (Darling-Hammond & Falk, 2014; Gordon & Campbell, 2014).

Performance Assessment systems in many redesigned schools are based on common, schoolwide standards reflected in projects that are integrated into daily classroom practices that use models, demonstrations, and exhibitions to show students the kind of work they will be expected to produce. Such assessment systems include, for example,

- portfolios of student work that demonstrate in-depth study through research papers, scientific experiments, mathematical models, literary critiques and analyses, arts performances, and so on;
- rubrics that embody the set of standards against which students' products and performance are judged;
- oral presentations (exhibitions) by students to a committee of teachers, peers, and others in the school to test for in-depth understanding and assess the student's readiness for graduation; and
- opportunities for students to revise their work and improve in order to demonstrate their learning and meet the standards.

A school's culture that supports performance-based learning systems typically hold a set of values—such as questioning and seeking understanding rather than seeking only right answers, persisting through challenges and failures, and seeing mistakes and errors as opportunities—that differ from traditional educational settings (see Figure 8).

Schools that teach through inquiry and project-based models must also have structures that provide teachers the time they need, individually and in teams, to support and evaluate performance assessments, to enable students to revise and improve their work, and to make adjustments to their curriculum and teaching based on the data they are observing and collecting through their students' learning processes.

### **Figure 8. School Culture Shapes Student Thinking in Math**

Research on school culture offers a compelling window into how schools shape not just what students know, but how they learn, and how they process information at a neurological level. A study led by Dr. Solange Denervaud, in collaboration with Dr. Mary Helen Immordino-Yang at USC CANDLE, explored how students, ranging from childhood to early adolescence, engaged in math learning across two different types of school cultures in Switzerland (Denervaud et al., 2020).

Traditional Swiss schools emphasize efficient mathematical skill learning and teacher-centered pedagogy that aims to guide students toward achieving correct answers to assigned math problems. Montessori schools, by contrast, center student-directed exploration, planning, peer learning, and independence. In Montessori approaches, the teacher guides students toward specially designed learning materials, and then students work together with these materials to figure out and use the mathematical concepts and skills. The study investigated how youth learning in the two types of schools may differ in how they approach a math task when the teacher is not present.

In the study, participating students were asked to solve math problems while undergoing fMRI neuroimaging. Students from both school types solved roughly the same number of math problems correctly, which might suggest the two approaches produce the same outcomes. But a closer look at the data tells a richer and more consequential story.

On average, the students in the Montessori settings attempted more problems at a faster pace and, as a result, got more wrong. Students from the traditional schools, on average, attempted fewer problems and skipped over more problems, indicating a disposition to avoid attempting problems when they were uncertain of the answer. These behavioral differences were associated with differences in brain activity, particularly in a region called the anterior cingulate cortex (ACC), which is a part of the brain that integrates cognitive, emotional, and bodily information and helps manage attention, and is critically important for detecting and learning from errors or other surprising information.

When the traditionally schooled students got an answer wrong, their brain activity suggested they were essentially frozen, unable to access a memorized solution pathway and caught in a state of negative emotion and arousal. When they got an answer right, their brains showed activity suggesting they were memorizing that correct answer for future retrieval.

Students from the Montessori schools demonstrated notably different patterns. When they got a correct answer to a math problem, their brains showed no measurable change in “cross talk” between the ACC and other brain regions; they simply moved on. But when they made an error, the activity in their ACC showed greater connectivity with frontal brain regions involved in

attention and strategic problem-solving, and in parietal regions involved in mathematical processing, suggesting that these students were strategically reprocessing the problem in order to figure out where they went wrong and learn from the mistake.

In other words, the findings suggest that the two groups of students had developed fundamentally different patterns of neurological processing during a math task. The findings suggest that traditionally schooled students had been shaped by their school's approach to teaching and learning to remember correct answers and avoid errors. Montessori school culture, on the other hand, had apparently been shaping students to think of errors as information, as opportunities to learn and to engage math processing more deeply.

Importantly, this is not simply a story about Montessori versus traditional schooling. It is a story about how the culture of a school, its values, pedagogical approach, and feedback loops between teachers and students, can build learners' dispositions. When students are habituated to pleasing teachers and satisfying external expectations for correct answers, they tend to develop a neurological orientation toward performance. When students are encouraged to explore ideas, take risks, and learn alongside peers, they tend to develop a neurological orientation toward discovery and growth.

This has profound implications for how we think about academic achievement. Surface-level outcome measures, like the number of problems answered correctly, can mask deeper differences in how students are developing as learners. Notably, in the study of Montessori and traditionally schooled students, machine modelling of the two groups of students' processing strategies revealed that over time, the Montessori-schooled students would have learned more math from the same opportunity to solve problems.

## 11. Community Connections and Civic Engagement:

Many high school educators see the value in curriculum and student learning experiences that, on the surface, connect to local and national issues, which can generate a stronger sense of connection for their students. However, relatively few schools strive to build a deeper sense of relevance for the

students through more experiential community and civic engagement opportunities that grow from their curriculum and school partnerships and promote transcendent thinking through the broader connections students are making in the process.

Civic inquiry can be embedded in any kind of class. For example, students in a statistics class might apply certain methods to a social issue they have identified, such as income and wealth distribution. Using national and local data sets and interviewing civil rights advocates, they analyze trends over time and look at variables such as geographic location and workers' rights laws in their own and other states, as well as people's education levels, gender, race and ethnicity. They present and debate what they find with each other, and then engage with local elected officials, and representatives of business and union interests to hear their perspectives. In writing up and reflecting on their learning, the students wrestle with their interpretations of the values and intentions behind policies and ultimately make recommendations for future improvements.

Social studies is another obvious site for civic learning and engagement. For example, *Democracy in Dialogue*, a program supported by the Smithsonian, involves classes of students across different state lines and contexts (e.g., rural and urban) that come together through writing letters and virtual meetups. As they learn about each other's daily lives, and tell stories about their home communities, they see how people's lives in different towns and cities in our country are similar and how they are different. By the end of the experience, they have read common texts and critically explored their perspectives on topics that are important to them.

The development of transcendent thinking is supported by opportunities to engage in community responsibilities and decision making from the classroom and school to the neighborhood and beyond. Schools that operate democratically and engage in community-connected learning support this development by coupling agency with purpose and civic mission. In California, the spread of community school designs supports these goals. When these community partnerships are implemented effectively, people and organizations from across the community come together and learn together how best to support students and families so that students are healthier and learn more, and the school feels like the heart of the community. UCLA Community School founding lead

teacher Rosa Jimenez explains how the community schools approach dovetails with a student-centered pedagogy and other features of effective secondary schools, including shared decision-making:

The fundamental difference [between a traditional school and a community school] is a commitment to democratic practices. We are constantly trying to figure out how to make decisions and problem-solve in a way that includes as many voices as possible. We've tried to flip the school hierarchy on its head and move away from traditional ideas of how a student learns and how teachers should think about their work. It allows for a lot of collaboration and a lot of decision-making and problem-solving using real data. ...We get to know our students and community and try to be responsive to those needs (Blank et al., 2023, pp. 101–102).

**Community-connected learning** is one outcome of this collaborative approach. This can take the form of projects in the community that support inquiry into community conditions and needs or that beautify or contribute to the community's assets. It can also take the form of experiential learning in the community, through internships, civic engagement, or service learning. When students see how the math, science, and social studies content they are learning connects to their community – and when their efforts can help improve the welfare of others – they both see the relevance of schoolwork and develop their own sense of personal and social responsibility.

All of these features come together in a growing number of schools in California. In Oakland Unified School District, for example, all of the high schools have become community schools and have adopted Linked Learning career pathway models that engage students in experiential learning. Though separate district initiatives, the Linked Learning and community school approaches share similar aims. Both prioritize incorporating authentic, community-based learning strategies; using integrated supports to mitigate out-of-school barriers to learning and to increase the relevance and rigor of curriculum and instruction; and leveraging the expertise of community stakeholders to improve learning and workplace environments for students.

All high school students in Oakland complete a capstone project in which they delve deeply into community issues that interest them, designing their own research that includes analyzing online and

print sources, analyzing data, and conducting field work in their local community, often engaging in an internship in a community-based organization. In addition to completing a significant research paper, students share their findings and analysis with peers, teachers, and the broader community in a formal presentation, and frequently take concrete steps to improve their community.

### **Figure 9. Redesign in Action: Oakland High School**

While Oakland High School is the sixth-oldest high school in California and the oldest in the city of Oakland, sustained redesign efforts have positioned the school clearly toward the future.

Oakland High has integrated its community schools' model with industry-themed Linked Learning pathways and dual enrollment opportunities to create vibrant, engaging, and community-centered learning experiences for its students, leveraging district- and state-level policies to do so. Students have access to six different industry-themed college- and career-preparatory pathways featuring project-based learning and internships that prepare them for the world beyond high school.

Community schools provide students and families with resources and structures that support them in thriving, and they anchor teaching and learning in the lived experiences, strengths, and expertise of the surrounding community (Community Schools Forward, 2023). Industry-themed Linked Learning pathways allow students to experience high-quality, authentic, and coherent learning experiences anchored in in-demand careers in fields like architecture and media (Guha et al., 2014). Pathways include dual enrollment courses in which students can earn college credit during the school day. The district's graduate capstone initiative, in which seniors complete a yearlong sustained research project, provides a North Star for high-quality project- and problem-based learning rooted in authentic, community-based issues (Maier et al., 2020).

Students do not just engage with capstone projects in their senior year. Pathway teachers are also helping students to develop a portfolio that they can use to demonstrate their learning and reflect on their growth by the time they reach 12th grade. Courses provide dynamic project-based learning and aligned, authentic assessments that prepare them for the world beyond high school.

Pathway teachers use weekly common planning time to coordinate instructional activities with one another, connect on student needs, and identify opportunities for authentic, work-based, and community-connected learning experiences outside the classroom. This time also allows educators to plan vertically, ensuring coherence in student learning experiences across grade levels within their pathway. The Public Health Academy pathway has used this time to develop integrated projects at each grade level, including a student podcast, a cross-cultural medicine book, and a senior project poster night—an opportunity for students to show off the work of their graduate capstone to an even broader audience (Measure N Commission, 2025).

Meanwhile, eleventh graders in the Law and Social Justice pathway partner with Y-PLAN, a partnership with the University of California at Berkeley’s Center for Cities and Schools, where they previously completed a capstone focused on supporting their unhoused peers. They conducted a survey with 177 students and 18 teachers and analyzed federal McKinney-Vento policies to generate actionable recommendations for Oakland Unified to implement, including hiring three new case managers (Center for Cities and Schools, n.d.).

Students also work as peer mentors for one another, helping foster a supportive and welcoming school climate while building students’ mental health skills. Students also play an important role in the school’s Culture and Climate team, a long-standing school committee that identifies and engages in problem-solving around school climate–related challenges. As students bring challenges to the attention of staff, they collaborate to develop structures that increase students’ sense of belonging.

By creating learning opportunities that allow students to explore issues of interest to them in school and community settings, the school provides a curriculum that draws on young people’s experiences and knowledge. For example, instruction within the Environmental Science Academy pathway—one of the small learning communities within the school—is focused on developing young people’s leadership skills through a student-centered and culturally sustaining curriculum. As science teacher M Fields explained:

A lot of our curriculum is focused on student-centered problems and student-centered leadership opportunities to solve those problems. In many cases, the curriculum at Oakland High is almost written as we go, in order to address problems that are cropping up throughout the year. ... We'll address environmental problems that crop up in our neighborhoods and in our communities.

In addition to prioritizing student-centered learning, teachers in the Environmental Science Academy pathway believe that their job is to be culturally responsive and to help students understand themselves, what they care about, and how they can positively impact social issues that matter to them. At the assembly welcoming incoming students, one of the codirectors of the pathway said:

We are the Environmental Science Academy, so obviously we care about the environment. We want all of you to be environmentalists. But, more importantly, we want you to figure out what you care about. So, if you want to be an activist to end the school-to-prison pipeline or fight for racial justice or end homelessness or fight for gender equality—whatever you feel passionately about—we want to help you become an ally, advocate, and activist for that cause. That's one of our core missions.

To achieve their pedagogical and instructional aims, Environmental Science Academy teachers prioritize project-based learning as a pedagogical approach, which allows for collaborative engagement in learning as students explore a relevant question or problem. For example, the “lake class” taught by Fields is designed around the ecology of Lake Merritt, a short walk from Oakland High’s campus. In an activity made possible through a partnership with the Lake Merritt Boathouse, students embark on pontoon boats once a week to survey different areas of the lake for various water quality factors and to collect samples for testing. Students then study the samples to determine the likely causes of water pollution and contaminants. After determining the pollution sources, students study potential policy interventions to address the health of their community lake. At the culmination of the class, students develop their own interventions to

address water quality, which they present to a mock city board made up of local scientists, advocates, and other industry professionals.

One student’s final project included building a three-dimensional map that, as Fields explained, “identified that the golf course above the cemetery was a likely source of nitrogen phosphate pollution due to the amount of fertilizer that they use, and he pinpointed this by testing the tributaries that come through that area. Below the golf course is a big, open cemetery that has lot[s] of grass everywhere. ... So the student proposed a replanting plan for the cemetery that included a native plant shrub forest that could soak up and absorb the nitrates and phosphates before they got to the lake.”

The lake class demonstrates how environmental science can be made relevant and culturally responsive by focusing on the environment as the space in which students live, work, and play. The Environmental Science Academy curriculum frames the environment as not just the melting of the Arctic shelf or the extinction of rare birds but also conditions of the local ecosystem, including Lake Merritt, which is a stone’s throw from the school campus. Furthermore, even as it builds science knowledge and research and writing skills, this project-based work requires use of social and emotional skills, as students must work collaboratively, communicate effectively, and manage and track learning that is important enough to support the hard work and revision needed to achieve mastery.

Since Oakland Unified School District began its redesign of high schools, suspension rates have dropped by more than half; graduation rates have increased significantly, especially for Black and Latino/a students; college preparedness has increased, as well as performance on state tests, including during the pandemic years, when most districts were experiencing declines (Klevan et al., 2023; Thompson, 2025).

## 12. Redesigning High School in California

There are many initiatives underway to transform secondary schools so that students have opportunities for meaningful learning, personalized supports, and connections to their futures. In California, the Linked Learning model – which has launched more than 600 pathways across the state in small schools and academies within large schools – features all of the elements described above. The initial stimulus for the spread of this model was an investment from the state’s Career Pathways Trust during Governor Jerry Brown’s tenure. The success of these schools in creating engaged, purposeful learning leading to positive school climates, strong school attachment, and improved academic outcomes (Casparly & Warner, 2020) led to expansion to many more districts and a renewed set of investments in Governor Newsom’s administration.

Other districts that have redesigned high schools for relationships, responsiveness, and purpose are supported by organizations such as Big Picture, the Internationals Network of schools, New Tech High and High Tech High networks, as well as Early College models, among others. Several major state initiatives are supporting change at the local level:

- The California Community Schools Partnership Program has invested \$4.1 billion since 2021 in developing community schools that support family and community engagement, integrated supports for students, expanded learning time, and shared decision-making in settings that support social and emotional learning and restorative practices (Swain et al., 2025) .
- The Golden State Pathways Program, established in 2022, invested \$500 million in industry-themed pathways, including Linked Learning, that offer integrated coursework and internships that can provide both high school and college credit.
- Investments in dual enrollment learning opportunities statewide, including an additional \$200 million in 2022, support high schools and community colleges in establishing opportunities for high school students to take credit-bearing college courses during the school day.
- The California State Seal of Civic Engagement (SSCE), enacted in 2017 and integrated into the state accountability system in 2026, recognizes high school students who demonstrate excellence in civics education, understanding of democratic principles, and active community participation. It requires meeting criteria like volunteering, leading community-connected

projects, and analyzing strategies for addressing civic issues. The seal encourages students to become informed, active, responsible citizens who positively impact their communities.

In 2025, the governor issued a Career Master Plan that creates a vision for integrating initiatives across the education, labor, and higher education sectors and proposes a Career Passport to recognize competencies that can be information for both employers and higher education institutions. Meanwhile, the State Board of Education is developing a Portrait of a Learner and Graduate that will define competencies to be developed and measured as the portrait is rolled out and implemented. The Career Passport may become a vehicle for that work.

In the 2025–26 budget, the state invested \$10 million in a pilot program to support secondary school redesign, which will continue to shape learning for both schools and state policymakers as it identifies opportunities for further innovations in policy and practice. The program is supporting 14 redesign networks representing 67 school districts that are actively working to transform California middle and high schools from factory model institutions to rich student-centered environments that develop strong relationships, and drive deep learning applied to complex, real-world challenges. It aims to build capacity, identify promising models, and share best practices statewide.

To sustain these initiatives, structures and systems must also change. The State is examining the many elements of the regulated system that may need to change to sustain new relational school structures; curriculum, assessment, and accountability systems pointed at deeper learning; and educator preparation that enables teachers and leaders to address students' needs for environments that enable their social, emotional, cognitive, and moral development.

## 13. Conclusion: Educating for Human Flourishing

Adolescence is a developmental period of tremendous promise. Emerging science demonstrates that when adolescents are supported to think transcendentally and reason civically, they not only deepen their scholarly learning but also cultivate the psychological and neural resources necessary for resilience, purpose, productivity and civic participation. Supports for such thinking can only happen in the context of safe and warm relationships, where young people feel valued and well known, and where adults hold high expectations and a deep sense of care for their students as they grow.

The reimagined high school must therefore move beyond a narrow focus on outcomes and compliance to create environments that honor adolescents' developmental needs and proclivities. Doing so is not an optional enhancement but a foundational responsibility, one that aligns education with human flourishing, and one that will produce larger academic gains over time.

If we wish to prepare the next generation not only for college and careers but for a lifetime of productive citizenship, creativity, and wellbeing, we must design high schools that support young people in developing their full potentials, and that work with, rather than at odds with, adolescents' desires for self-actualization, social engagement, and powerful ways of knowing and understanding. Adolescents must feel safe to take intellectual risks and grapple with big ideas, and supported to connect their motivations and emotions with transcendent thinking and deeper learning. Our youth are driven to author meaningful narratives about themselves and their world; schools should be designed to help them.

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