



THE SCIENCE OF ADOLESCENT LEARNING

How do teenagers
learn and grow?

We've learned so much in the last decade about the amazing world of the mind and our capacity for continuous learning.

By understanding and applying the fundamentals of brain science, we can empower young people to become agents of their own learning journeys.

THINGS TO THINK ABOUT

The science of learning and the brain are revealing more and more about how adolescents develop into capable, independent, and confident adults.

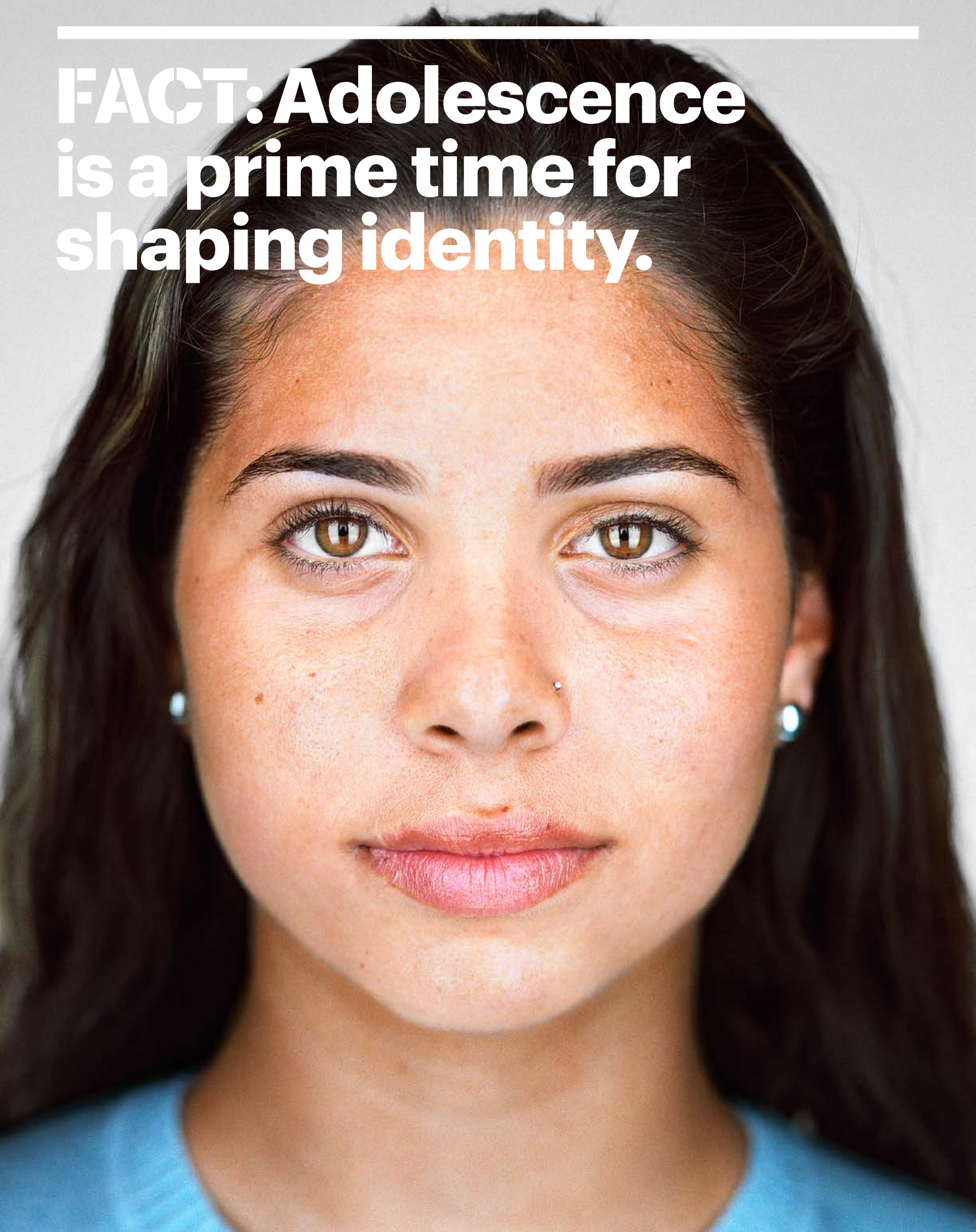
What are the implications of this new information in a school setting?

What innovative schools, organizations, or programs exist in your network that are already applying this knowledge?

Can you reach out to them as a source of information and inspiration?

HOW YOUNG PEOPLE LEARN

**FACT: Adolescence
is a prime time for
shaping identity.**



Understanding the adolescent brain

Until recently, scientists believed that the vast majority of brain development took place in early childhood. Research over the past decade, however, has turned that assumption on its head. New brain imaging technology reveals that brain structure and brain function are still undergoing significant development during the adolescent years.

For educators, the lesson is simple and encouraging: you can't give up on high school students, because their development is far from over. When you push young people to think deeply, make connections, and develop higher-order thinking skills, they're not just adding to what they know—they're building the fundamental capacity of their brains.

In fact, we are making new discoveries about what makes adolescent brains distinctive all the time. For example, when a team of researchers at the University of Oregon studied the brains of teenagers using fMRI (functional magnetic resonance imaging), they found that the prefrontal cortex — the part of the brain responsible for things like decision-making, impulse control, and prioritization — behaved differently than the brains of adults. This explains why teenagers sometimes act up, and it also explains why it is a special opportunity to engage them in trying new, creative ways of being and doing.

A good learning environment acknowledges that the primary mandate of young people is identity formation, and provides them with opportunities to safely envision themselves as the adults they want to become.

THINK ABOUT

The adolescent brain is malleable. According to Temple University psychologist Lawrence Steinberg, this is a double-edged sword: teen brains are especially susceptible to harmful experiences, but they are equally responsive to positive experiences that promote growth. What can you do to design experiences that mold the teenage brain in positive ways?



JoEllen Lynch and Karen Mahler have outlined five tenets of positive youth development that can guide the design of schools:

1. Youth need caring, trusting, and supportive relationships with adults and other young people.
2. Youth respond to high expectations.
3. Youth need opportunities to contribute (often referred to as *choice and voice*).
4. Youth need learning experiences that are intentionally engaging, related to their authentic interests, offer opportunities to succeed, and provide feedback to enable them to reflect on their accomplishments.
5. Youth need all of these aspects to be continuously present.

YOUTH DEVELOPMENT AND SCHOOL DESIGN

How do we design schools with the science of youth development in mind? JoEllen Lynch and Karen Mahler summarize a wide range of research about youth development and ideas of how to apply the science to school design.

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MIND, BRAIN, EXPERIENCE, AND SCHOOL

Recent years have seen amazing advances in our understanding of how young people learn. Explore how scientific findings on the adolescent brain are inspiring educators in this book by John D. Bransford, Ann L. Brown, and Rodney R. Cocking.

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TEACHING ADOLESCENTS TO BECOME LEARNERS

How do we support young people in owning their identities as learners and thinkers? The Chicago Consortium's in-depth review of the five categories of noncognitive factors related to academic performance highlights the skills, attitudes, and behaviors crucial to learning.

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MYSTERIES OF THE ADOLESCENT BRAIN

Sarah-Jayne Blakemore, of University College London, explains why scientists are finally able to work toward a clear picture of how adolescent brains develop.

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**FACT: Intelligence
is not fixed.**



Developing a growth mindset

Stanford University psychologist Carol S. Dweck showed that students' mindsets are critical to their capacity to develop strong learning identities. She defines mindset as a self-theory, or a perception students hold about themselves. Students who have a fixed mindset believe basic qualities like intelligence and talent can't be changed—so they spend their time documenting rather than developing their own capabilities. Students with a growth mindset understand that intelligence and talents can be developed through perseverance and hard work. Because they know this, they are active, risk-taking learners committed to overcoming obstacles and striving for accomplishment.



JO BOALER
Author and Professor of
Mathematics Education,
Stanford Graduate School
of Education

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THINK ABOUT

What if teachers said, "You must have worked very hard," instead of, "You are so smart"? How would this affect how much harder students try next time?

"When you enter a mindset, you enter a new world. In one world (the world of fixed traits) success is about proving you're smart or talented. Validating yourself. In the other (the world of changing qualities) it's about stretching yourself to learn something new. Developing yourself."

CAROL S. DWECK

Author, *Mindset: The New Psychology of Success*

How to Foster a Mathematical Mindset:

- + The beliefs students hold about themselves can change everything, even the way their brains work
- + One of most important things anyone can do for mathematics learning is to believe in themselves
- + No one is born with a math brain and anyone can achieve at high levels through hard work
- + If students can hold on to the belief that they can do well, and keep that belief even when people are giving them the opposite message, then they can achieve anything.

JO BOALER

Author, *Mathematical Mindsets*

DEVELOPING A GROWTH MINDSET

Have you heard of the *power of yet*? In an engaging introduction to the concept of the growth mindset, Carol S. Dweck shares ways to grow the brain's capacity to solve tough problems.

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THE SCIENCE OF SCARCITY

Check out Harvard economist Sendhil Mullainathan's research into scarcity, and how poverty and having too little of anything affects our ability to make decisions.

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EMBEDDING YOUTH DEVELOPMENT IN SCHOOLS

Thought leaders Michele Cahill and Karen J. Pittman discuss how strong schools can empower students to discover their identities and take charge of their own learning.

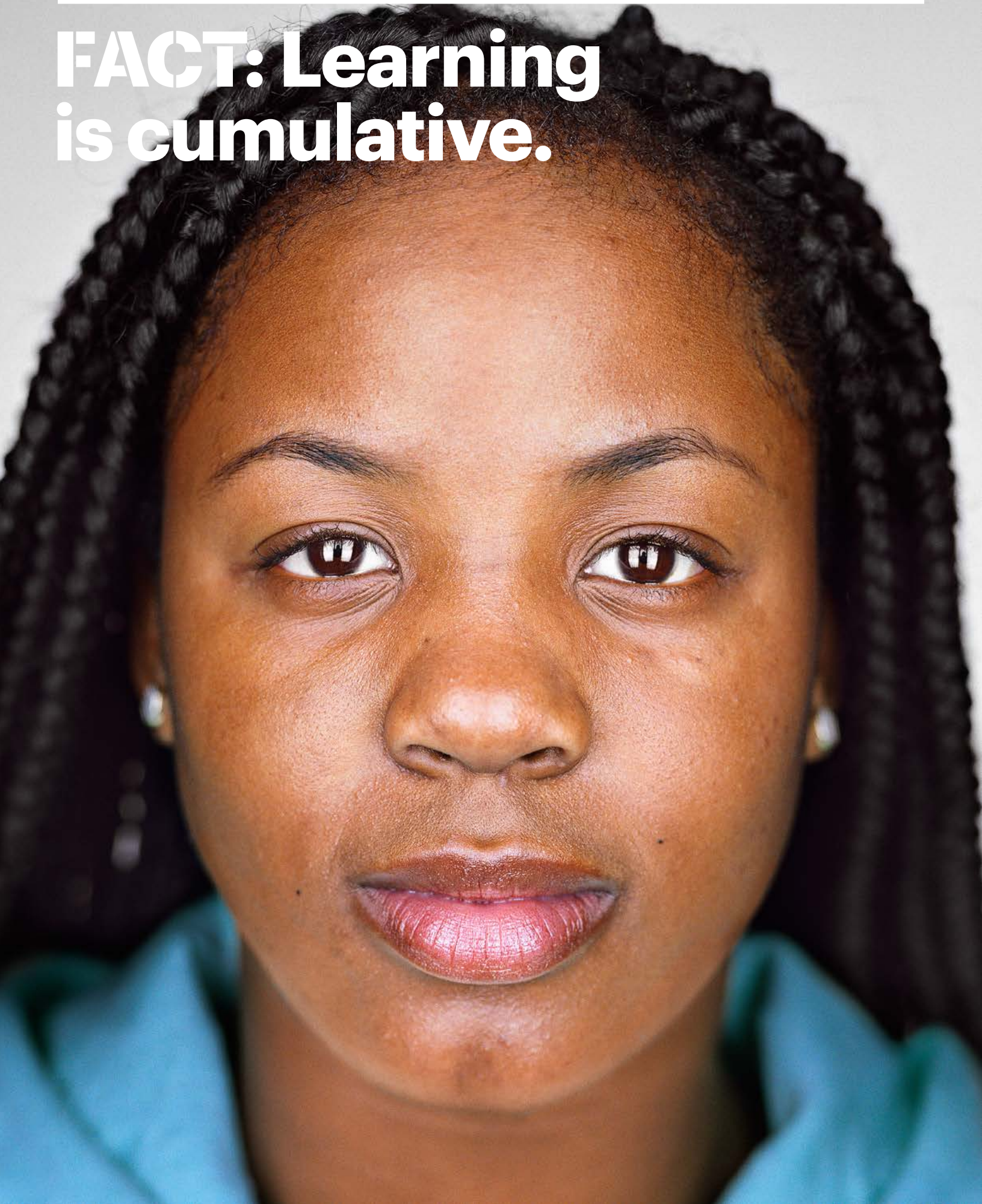
LISTEN ▶

STUDENT MOTIVATION

Clayton M. Christensen applies lessons from business to motivate learning by students in the classroom.

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**FACT: Learning
is cumulative.**



To develop new skills, people must build on a foundation of prior skills and knowledge.

Many aspects of learning are cumulative. That is, certain types of learning build on other learning in predictable ways. For example: you have to understand fractions in order to do algebra. And you have to be able to read fluently in order to absorb the information in a complex essay question.

Teenagers' brains develop faster when they're challenged with successively more sophisticated ways of thinking to accompany the acquisition of new skills. Not all cognitive progressions are linear, so we have to combine the type that is with the type that isn't for optimal learning to take place. What does this mean for educators? First, we need to make sure that our students are developing the foundational skills required to move on to higher levels of learning; then, we must provide them with opportunities to test out their skills with demanding content. The repetition of these two steps throughout a young person's learning journey across disciplines is the most effective way to engage their brains.

Too often, students who are underprepared for high school are assigned to remediation classes that are neither engaging nor effective. It's up to us to come up with instructional strategies that help students stay motivated and engaged on their learning pathways while investing ambitious efforts into finding future success.

THINK ABOUT

What does new knowledge about learning and brain science tell you about how adolescents develop into capable, independent, confident adults? What are the implications for schooling?



"Learn math the way you'd learn anything, like riding a bicycle. Stay on that bicycle. Fall off that bicycle. Do it as long as necessary, until you have mastery. The traditional model penalizes you for experimentation and failure, but it does not expect mastery. We encourage you to experiment. We encourage you to fail. But we do expect mastery."

SALMAN KHAN
Founder, Khan Academy

MAKING MASTERY WORK

This article from the Nellie Mae Education Foundation explains what mastery learning is, how it works in 11 schools, and how you can incorporate it into your school design.

READ ▶

UNDERSTANDING BY DESIGN

How do you move from a focus on seat time and coverage to a focus on true understanding? Grant Wiggins and Jay McTighe offer insights on how to design your school, from the curriculum to the culture, so students deeply understand what they learn.

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SELF-DIRECTED LEARNING

How can schools develop self-directed learners? Monica Martinez surveyed teachers and principals to get their recommendations on how to enable students to take responsibility for their learning.

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KHAN ACADEMY ON UPENDING LEARNING

Can the Khan Academy use what they know about how we learn to upend and democratize SAT prep? Find out in this article in *Wired* magazine.

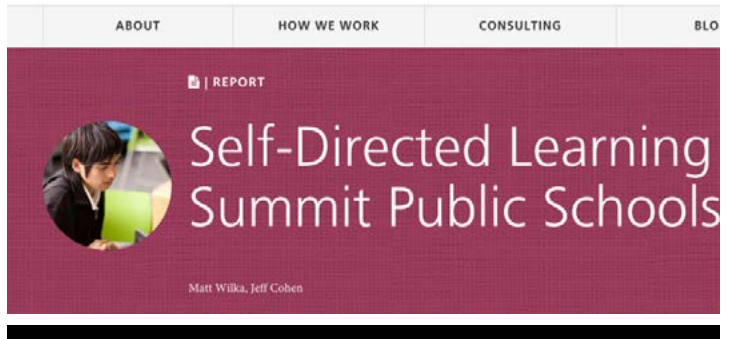
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Our learning environments must be adapted according to this new knowledge.

It's going to take some original, generative thinking to transform all we know and really shake things up.

How does this new knowledge of the adolescent brain impact schedules? Technology use? Interaction models? Assessments and tracking tools? Use of teachers' time? Classroom environments?

GET INSPIRED



SIX SCHOOLS TO WATCH

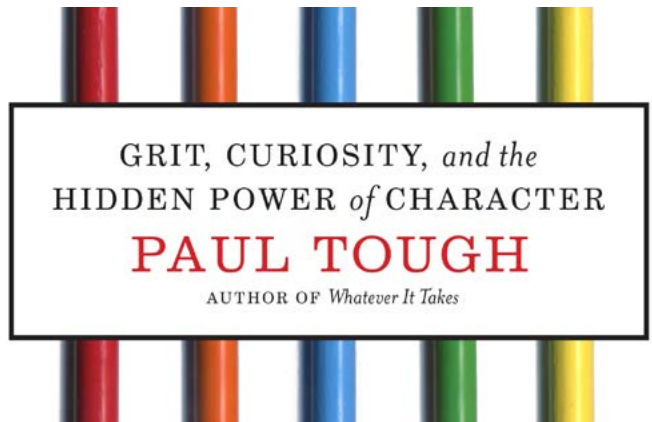
How do mastery-based high schools work in real life?

PROFILING SUMMIT PUBLIC SCHOOL

Check out a school experimenting with self-directed learning.

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YOUCUBED

Math and developing a growth mindset go hand in hand.

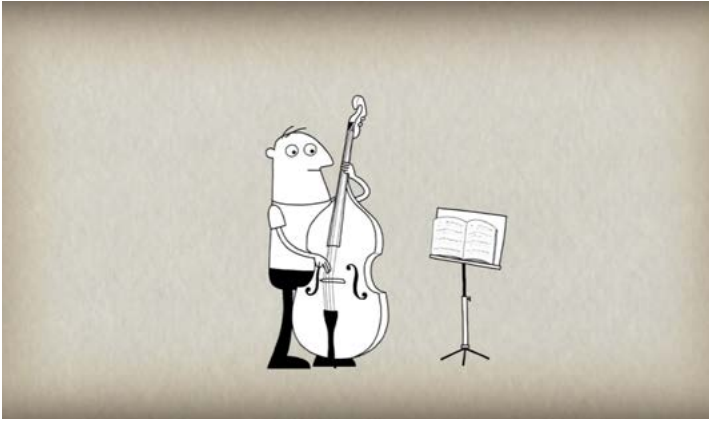
HOW CHILDREN SUCCEED

Why do some children succeed in harsh conditions while others flounder? Paul Tough's book covers the importance of perseverance, curiosity, and character in preparing children to face adversity.

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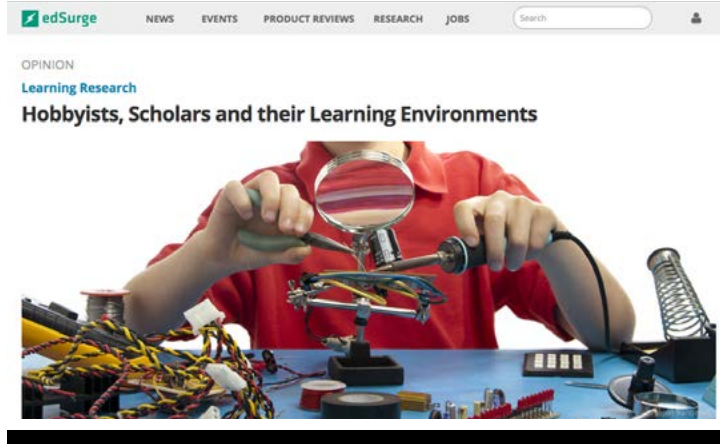
GET INSPIRED



INSPIRATION FROM MUSIC

Learn how playing music benefits your brain in this TED Talk from educator Anita Collins.

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IGNITING INTEREST

How can the right learning environment help students transform themselves from mere compliers to real scholars? Find out in this article on EdSurge.

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GET CREATIVE



FIND THE NEW BRAIN SCIENCE

with Keith Yamashita

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KEITH YAMASHITA,
Chairman and
Founder, SYPartners

**START
MAKING
YOUR
RADICAL
IDEA.**