

# The Science of Adolescent Learning

How do teenagers learn and grow?

**2**  
EDITION



**We've learned  
a great deal in  
the last decade  
about the human  
brain and our  
capacity for  
continuous  
learning.**

**Advances  
in psychology  
and neuroscience  
are fundamentally  
changing the way  
we understand  
how adolescents  
develop into  
capable,  
independent, and  
confident adults.**

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

# THINGS TO THINK ABOUT



**01**

What are the implications to education of new information about adolescent psychology and brain development?



**02**

How are innovative schools, organizations, and/or programs applying this knowledge in new and interesting ways? What can we learn from their work?



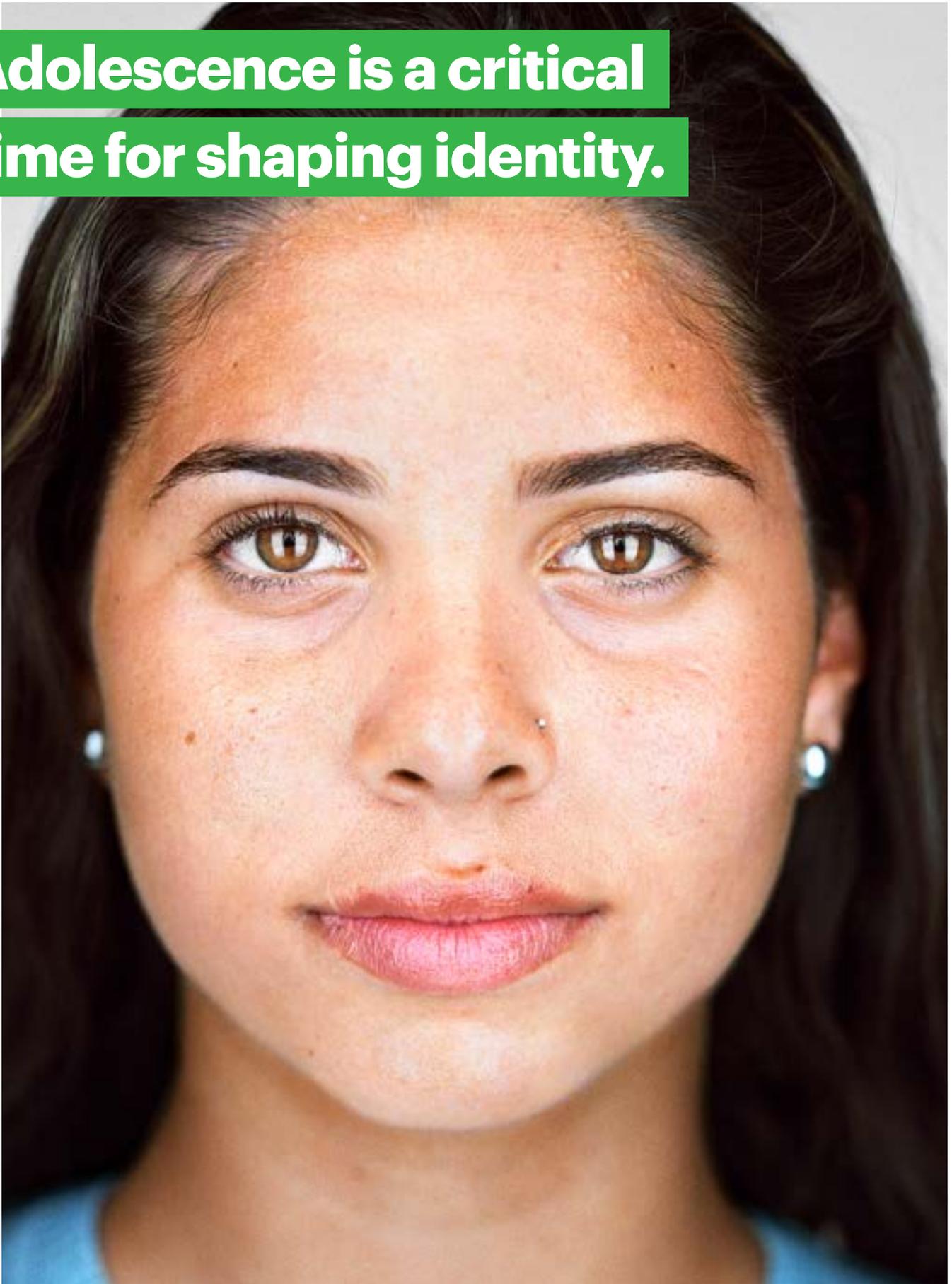
**03**

How can schools foster intellectual development and the growth of positive identity by making learning deeper and more engaging? How can we help students appreciate their growing competence and experience satisfaction and joy in their own identities as learners?

# HOW YOUNG PEOPLE LEARN

## FACT 07

**Adolescence is a critical time for shaping identity.**



# Understanding the adolescent brain.

Until recently, scientists believed the vast majority of brain development took place in early childhood. Research over the past decade, however, has shifted the way we look at how the brain develops over time. We now know that the structure and function of the brain continue to develop significantly 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 young people 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.

Researchers at the University of Oregon used fMRI (functional magnetic resonance imaging) to identify the parts of the brain that develop later in life. They found that, for teenagers, the prefrontal cortex—the part of the brain responsible for things like decision making, impulse control, and prioritization—continues to build over time and functions differently than in the brains of adults. This helps us understand why teenagers sometimes act up, and is proof that high school is a critical time to engage students in new, creative ways of learning and doing.

Good learning environments should provide young people opportunities to develop their identity and safely envision themselves as the adults they want to become.

## Think About →

The adolescent brain is malleable. According to Temple University psychologist Laurence Steinberg, this is a double-edged sword. While teen brains are susceptible to harmful experiences, they are equally responsive to positive experiences that promote growth.



**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. →

## Teaching Adolescents to Become Leaders

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. →

## Mind, Brain, Experience, and School

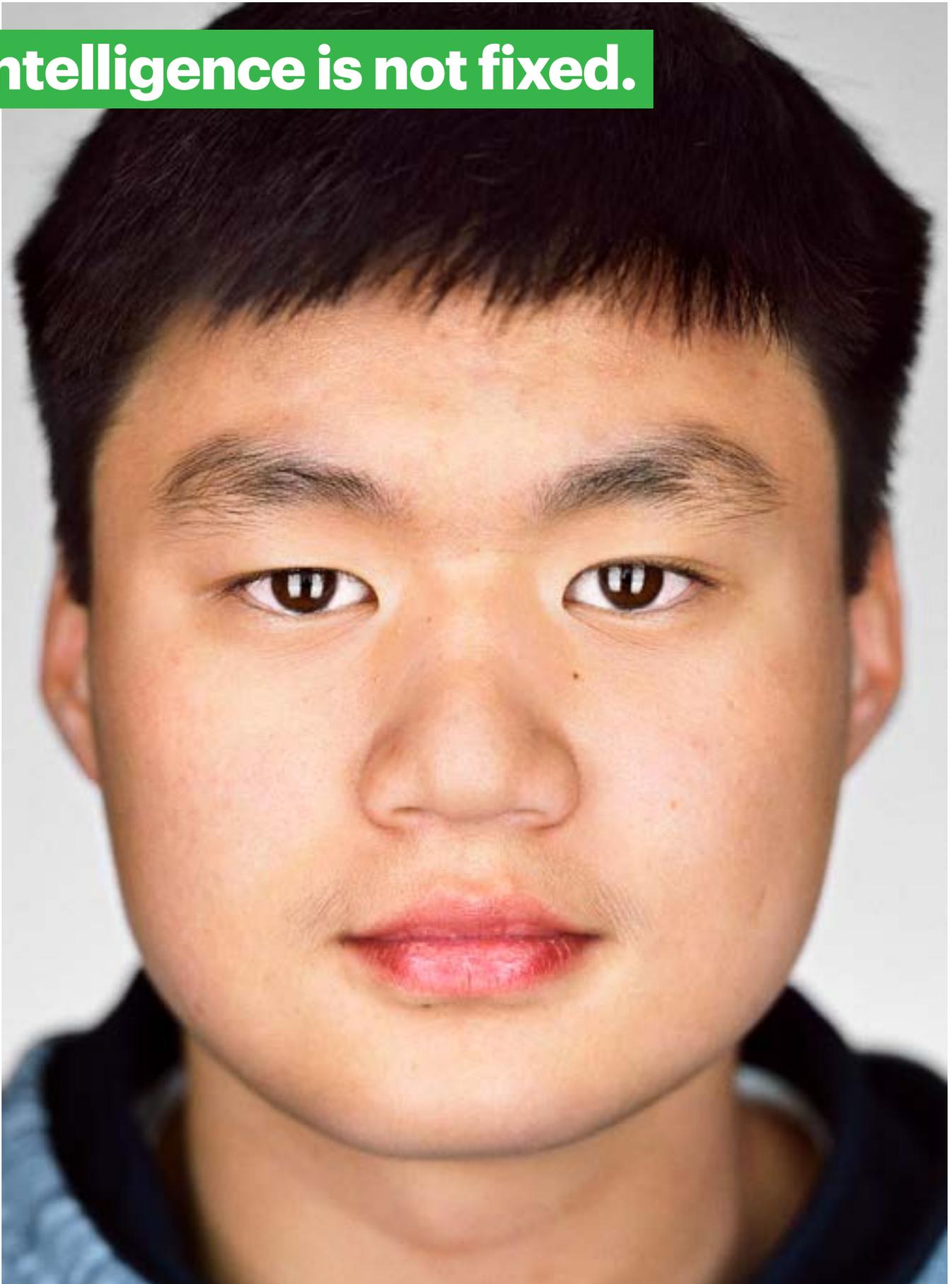
Recent years have seen amazing advances in our understanding of how young people learn. Explore how scientific findings on the adolescent brain are inspiring educators in this book by John D. Bransford, Ann L. Brown, and Rodney R. Cocking. →

## 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. →

## FACT 08

**Intelligence is not fixed.**



# Developing a growth mindset.

The way we think about learning has a huge impact on how we acquire and retain knowledge. A student's mindset, according to Carol S. Dweck, a psychologist at Stanford University and author of *The New Psychology of Success*, is critical to the capacity to develop strong learning identity. She defines mindset as a self-theory, or a perception students hold about themselves. Students with 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. Thus, they are active, risk-taking learners committed to overcoming obstacles and striving for accomplishment.

"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," says Dweck.



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



## Think About →

What if a teacher said, "You must have worked very hard," instead of, "You're so smart"? How might the way we validate effort affect how students approach their work?



### How to foster a mathematical mindset, from Jo Boaler, author of *Mathematical Mindsets*.

- + The beliefs students hold about themselves can change everything, even the way their brains work.
- + One of the 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.

## 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.



## How Kids Really Succeed

In a thoughtful article in *The Atlantic*, Paul Tough explains how schools can help students growing up in difficult circumstances overcome the effects of adversity.



## 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.



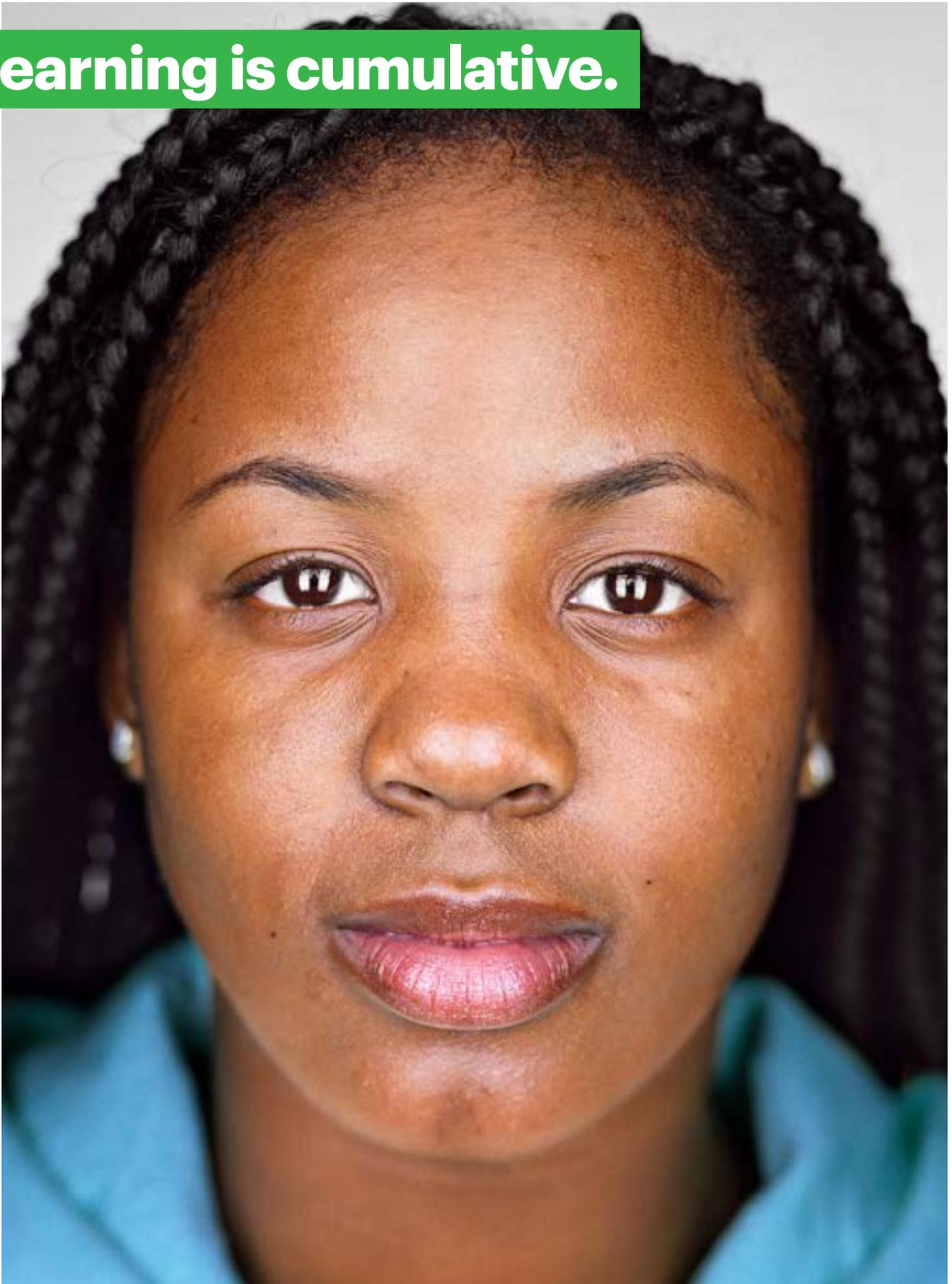
## Student Motivation

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



## FACT 09

**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 learn better when they're challenged with successively more sophisticated ways of thinking. Not all cognitive progressions are linear, so for optimal learning to take place, students need to practice multiple types of thinking. They need to develop foundational skills, and then test and stretch those skills with demanding content in order to move to higher levels of learning. The repetition of these two steps throughout a young person's learning journey is the most effective way to engage their brains.

Too often, students who get to high school without the foundational skills they need are assigned to classes that are not truly engaging. Instead, they need a curriculum that fascinates and challenges them, that connects with their interests as adolescents. And they need instruction that helps them stay motivated, encourages them to work hard, and purposefully enables them to develop the skills they need to do successively more demanding work.

Think About →

What does new knowledge about learning and brain science tell us 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's working in 11 test schools, and how you can incorporate it into your school design.



## Understanding by Design

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.



## 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 own learning.



## 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.



**High  
schools  
need to  
change  
fundamentally  
to apply  
what we  
now know  
about how  
young  
people  
learn**

**It's going to take original, generative thinking to transform how we provide learning experiences for young people.**

How might a deeper understanding of the adolescent brain affect school schedules? School culture and relationships? Technology use? Instructional 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 that's experimenting with self-directed learning.



## youcubed

Math and developing a growth mindset go hand in hand.



## The Uncomfortable Effort of Thinking

How the brain works, how we learn, and why we sometimes make stupid mistakes, from Veritasium.



## Inspiration from Music

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



## Igniting Interest

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



# GET INSPIRED



## Learning Science and School Design

How do we design for cognition and motivation? In this presentation, Transcend's Jenn Charlot and Bror Saxberg explain why educators should never ignore learning science.



## Insights from Behavioral Science

University of Virginia's Ben Castleman talks about how text messages can reduce "summer melt" in college matriculation.

