Digital Initiatives in STEM Education

Learning with technology is a 200,000-year-old tradition

If you think the "information technology" transformation in schools and workplaces is new to the 21st century, you might want to look back thousands of years. Using technology to learn, play, and develop skills is a continuation of our quest to survive and adapt. About 77,000 years ago, we used baboon bone and ochre plaques. Today, we use tablets, smartphones, and video games.

200,000 Years Ago

During dramatic climate changes, human ability to craft tools and teach offspring is fundamental to survival.

Children learn to survive and contribute to society by playing with bows and arrows.

Now

During rapid information technology changes, humans increasingly rely on digital technology to thrive.

Children learn to survive and contribute to society by playing with information.

4 out of 5

In a nationwide sample of nearly 2,400 families, more than four in five K-12 students occasionally use some sort of computing device such as a tablet, a smartphone, and/or a laptop computer.

164,000 Years Ago

Modern humans collect and cook shellfish to make a living.

Now

Modern humans collect and analyze data to make a living.

19th Century:

New jobs in the Industrial Revolution require the ability to read and write.

21st Century:

26 million U.S. jobs (20% of all U.S. jobs) require a high level of knowledge in any one STEM (Science, Technology, Engineering, Math) field.

STEM jobs have doubled as a proportion of all jobs since the Industrial Revolution.

15.68 M
Americans are projected to be employed in STEM fields by 2018.

71%
of STEM jobs by 2018 are projected to be in computing.

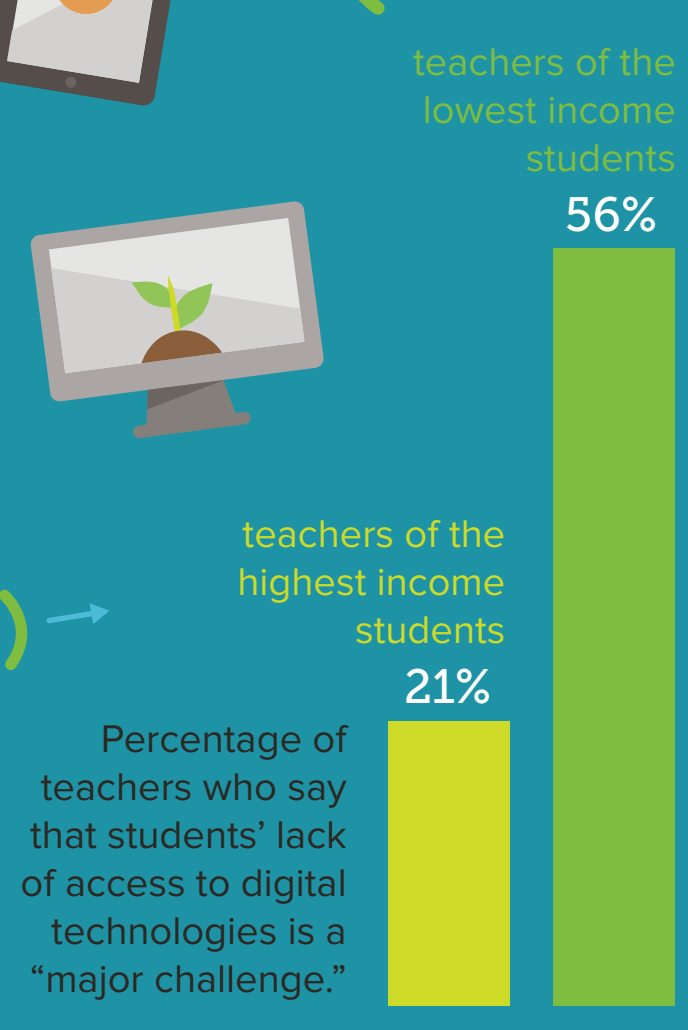
$10 trillion annually
is the estimated total of global online transactions. The human economy is web-based.

Digital literacy and STEM education go hand-in-hand...

96%
of Americans use new communication technologies as part of their daily lives.

62%
of Americans use the Internet as an integral part of their jobs.

but not in everyone's hands:



32%
of U.S. households lack broadband service.

73%
of Advanced Placement (AP) and National Writing (NW) teachers say that they and/or their students use mobile phones in the classroom or to complete assignments.

84% of AP and NW teachers say: "Lack of access to digital technologies is leading to greater disparity between affluent and disadvantaged schools and school districts."

130,000 Years Ago

Modern humans form person-to-person social networks, exchanging resources over long distances.

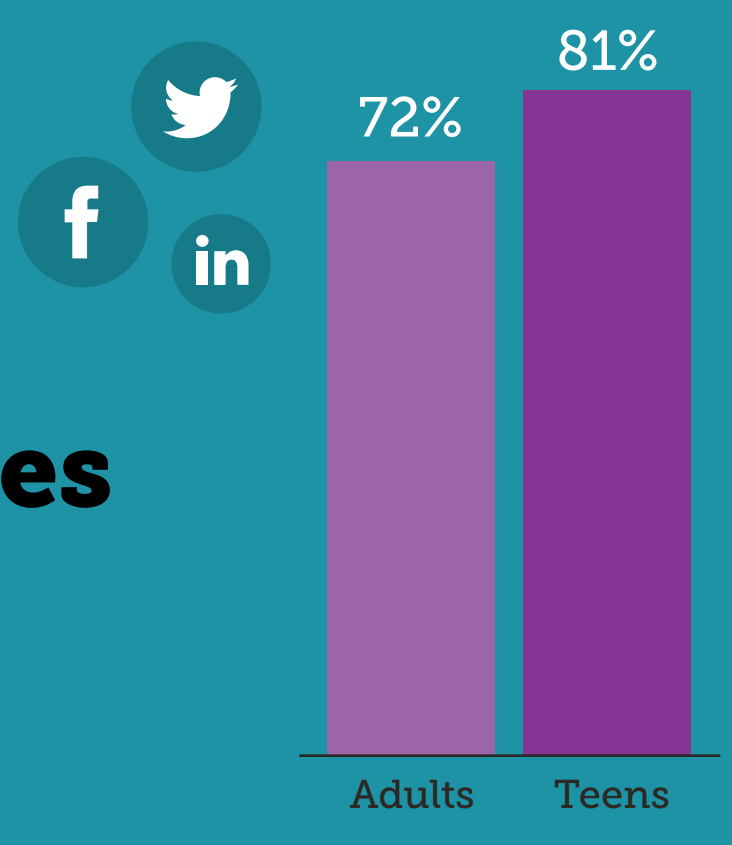
186 miles
is the distance humans walk to trade between groups, obtain materials, and cement alliances.

Now

Modern humans form digital social networks, exchanging information over long distances.

25,000 miles
is the circumference of the Earth: the distance humans can exchange information without taking one step.

U.S. population active on at least one social networking site

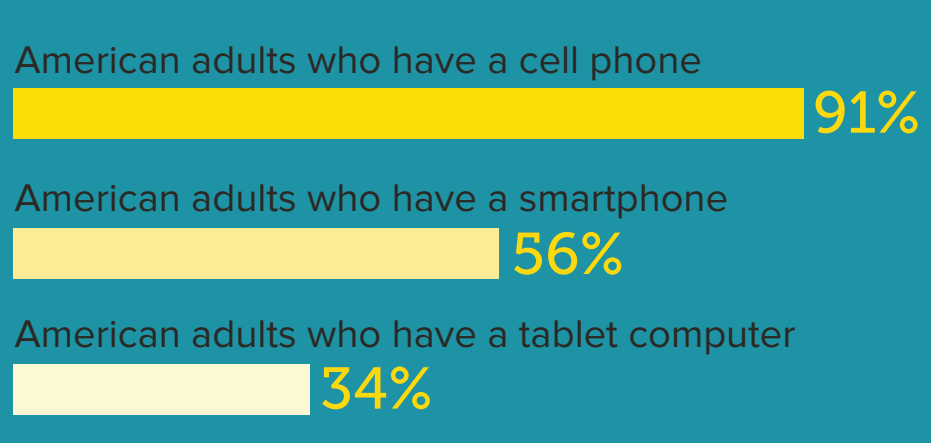


90,000 Years Ago

Modern humans make tools for gathering plants.

Now

Modern humans use tools to gather information.



Mid-1990s to Today:

"Generation Net" kids are born. They don't think in terms of technology; they think in terms of the activity technology enables.

They are oriented toward inductive discovery or making observations, formulating hypotheses, and figuring out the rules.

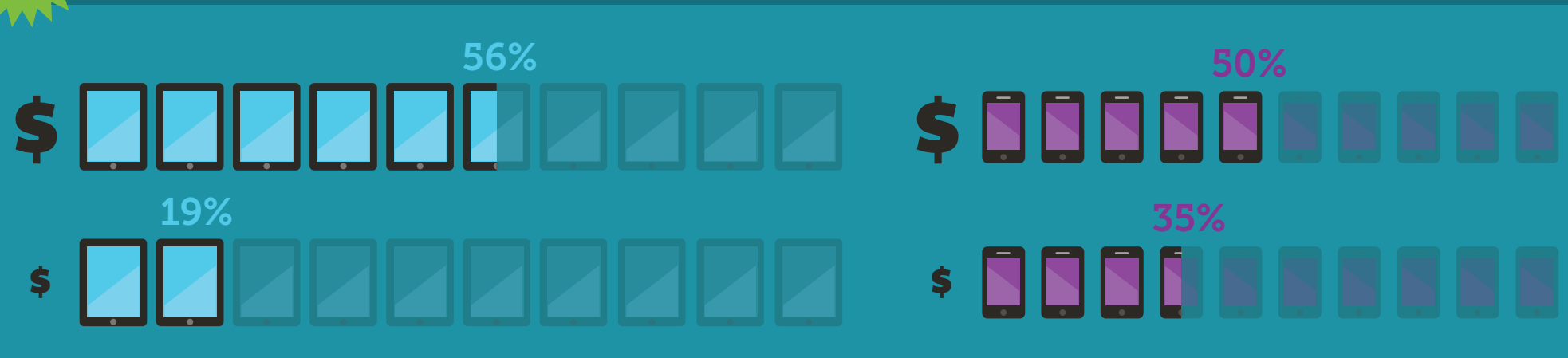
They are more comfortable in image-rich environments than with text.

10,000 hours vs. 5,000 hours
is the time U.S. Gen Net will have spent playing video games vs. reading by the time they are 21 years old.

23%
of teens have a tablet computer, a level comparable to the general adult population.

43%
of teachers and students use tablet computers in the classroom or to complete assignments.

Opportunity for virtual learning depends on socioeconomic status:



Teachers of low income students are 37% less likely than teachers of the highest income students (56%) to use tablet computers or e-readers in their classrooms.

Over half of teachers of upper and upper-middle income students say their students use cell phones to look up information in class vs. 35% of teachers of the lowest income students.

12,000 Years Ago

A Turning Point

Modern humans learn they can control the growth and breeding of plants and animals and discover activities that transform Earth's natural landscapes.

Now

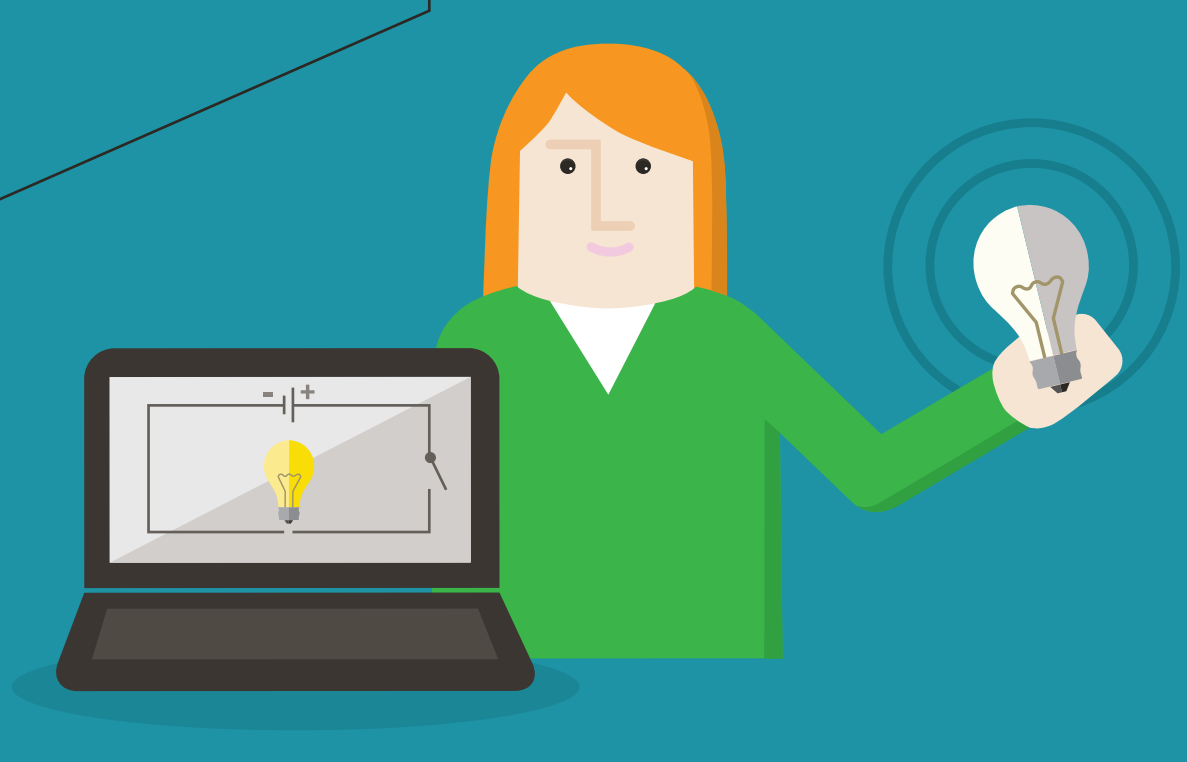
Education Game Changers

Modern humans find they can influence the growth and development of students of all ages with digital activities that are transforming learning landscapes everywhere.

170 million
Americans play video games — 55% of the U.S. population.

Games drive innovation in industry:

- Graphical Processors
- Artificial Intelligence
- Human/Computer Interaction
- Massively Multiplayer Environments



Computer simulations and games are catalysts to new approaches in science education:

- ✓ They enable learners to see and interact with representations of natural phenomena that would otherwise be impossible to observe.
- ✓ They motivate learners with challenges and rapid feedback.

Smithsonian Science Education Center assists in nurturing the ongoing development of tomorrow's tech-literate generation.

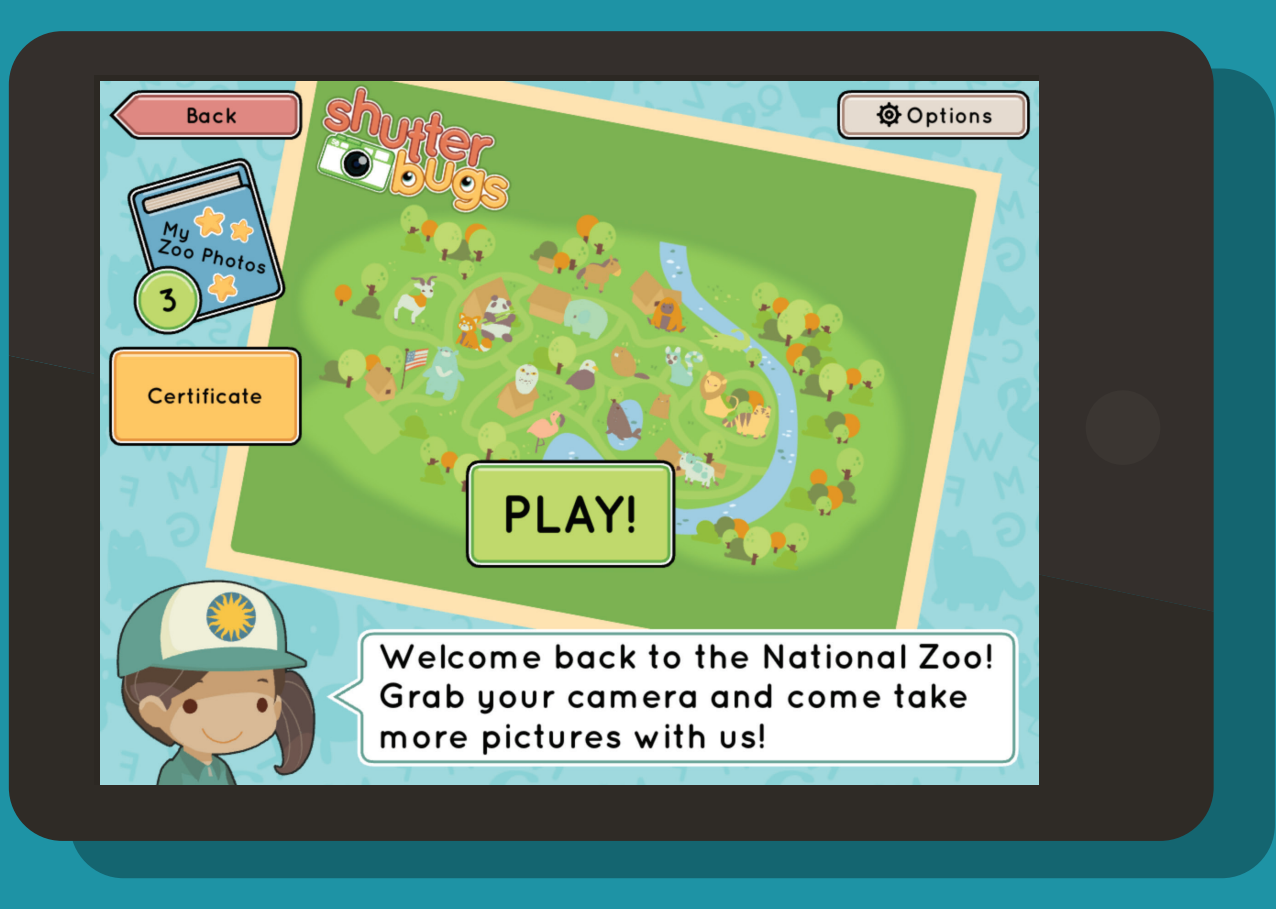
28-year legacy

in inquiry-based science, developing authentic learning materials for classrooms nationwide.

SSEC develops a science standards-aligned kindergarten app for its STC™ program called **Shutterbugs: Wiggle and Stomp**.

shutterbugs Wiggle and Stomp

- adapts quickly to each player
- provides children, parents, and teachers with feedback about the child's progress
- works on most current research about how children learn
- rigorously user-tested with children and educators



95%
of teachers use digital games that were designed specifically for educational use.

70%
of teachers agree that using digital games increases motivation and engagement.

62%
of teachers report that games make it easier to effectively teach the range of learners in their classroom.

> **"I want you guys to be stuck on a video game that's teaching you something..."** *-President Barack Obama, TechBoston, March 2011*

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SOURCES: Visual.ly; Transforming Science Education, Smithsonian Science Education Center; Humans Change the World, Smithsonian Museum of Natural History; Fact Sheet: Digital Literacy, The U.S. Department of Commerce; Living and Learning with Mobile Devices; What Parents Think About Mobile Devices forEarly Childhood and K–12 Learning, Grunwald Associates LLC; The Hidden STEM Economy, Brookings Institution; Is It Age or IT: First Steps Towards Understanding the Net Generation, Educause; Where are the STEM students? ASTRA, the Alliance for Science & Tech Research in America; How Teachers Are Using Technology at Home and in Their Classrooms, The Pew Research Center; Report: Social Networking, Internet & American Life Project, The Pew Research Center; Pew Internet & Mobile, Internet & American Life Project, The Pew Research Center; Teens and Technology 2013: Internet & American Life Project, The Pew Research Center; NASA, Goddard Space Flight Center; Teacher Attitudes about Digital Games in the Classroom (2012), The Joan Ganz Cooney Center at Sesame Workshop; Games For Grand Challenges, Office of Science and Technology Policy, The White House; Learning Science Through Computer Games and Simulations (2011); National Academy of Sciences