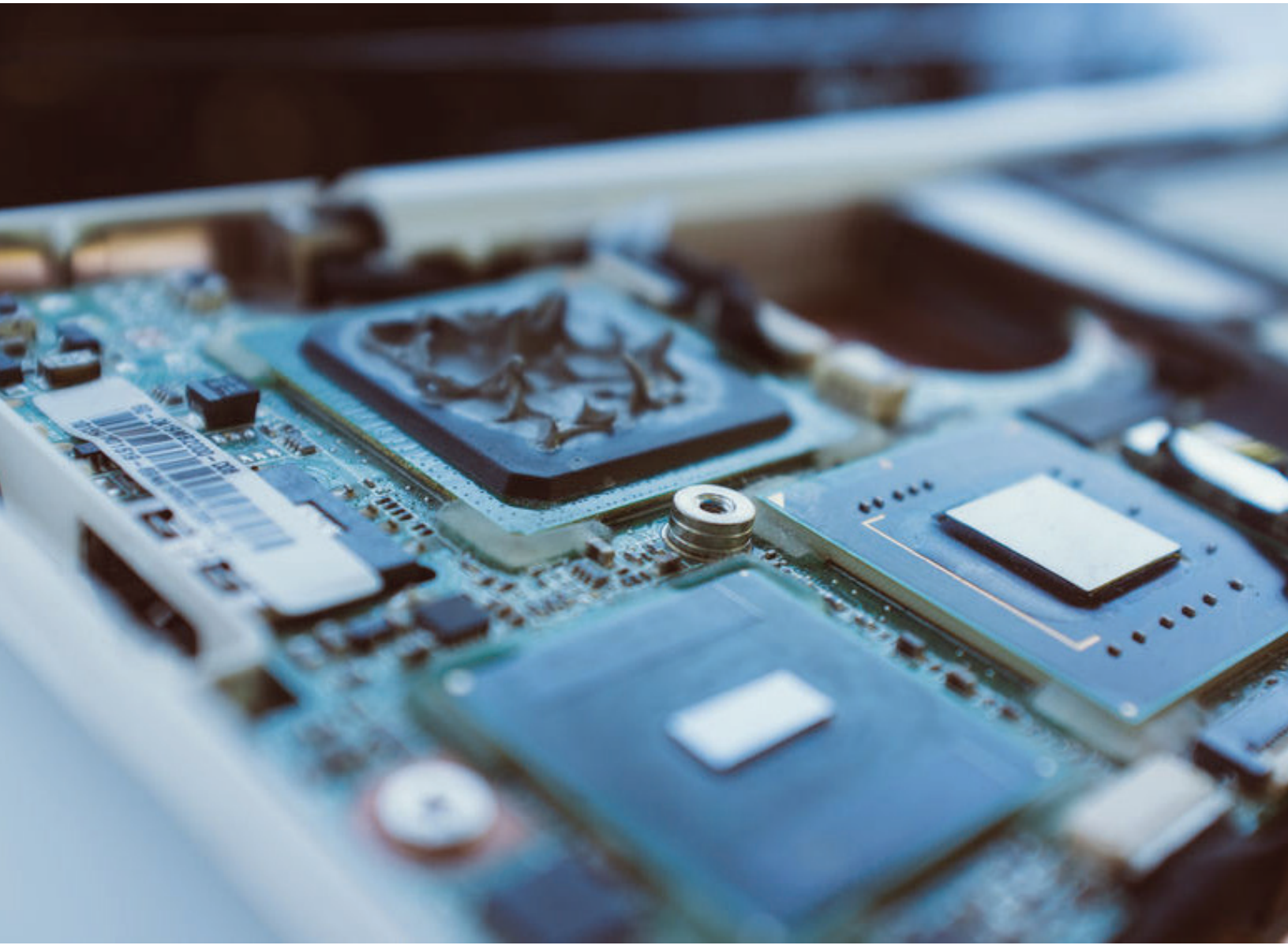
Connecting to Computer Science:
A Resource for Afterschool Practitioners



Afterschool Alliance

We're surrounded by technology—smart phones, tablets, computers, video games, mobile apps, etc.—and today's youth must learn how to use it effectively. But what if there's a grander vision? Let's empower and equip students with the knowledge and tools to become **creators of technology**!

From the Afterschool Alliance's 2016 survey of afterschool practitioners, we know that high numbers of afterschool programs have a keen interest in computer science education. And many have experience providing computer science to their students, with activities ranging from robotics to video game design to interactive electronics!

Despite high interest levels, common obstacles get in the way. Computer science education of course requires access to technology, internet connectivity, and funding. But beyond that, we know that it's especially challenging to find qualified staff and curriculum specifically designed for the out-of-school time environment. The same levels of professional development and variety of quality curriculum just don't exist for computer science in the same way it does for the other STEM topics like science and engineering.

While there's been progress in creating resources for afterschool and summer programs in the past couple years, there's still a long way to go! In the meantime, this guide pulls together some existing resources, curricula, and research to get you and your students coding.

In this Guide

Activities and Curriculum

Many organizations and companies develop technology and computer science educational products. We selected the following items as they were developed for, or work well in, the out-of-school time environment. Many afterschool and summer programs adapt in-school resources, but this takes additional time, resources, and expertise.

Computer Science for All
You for Youth

Run by the Department of Education, You for Youth (Y4Y) provides online professional development, technical assistance, and resources geared towards 21st Century Community Learning Center programs. The Y4Y Computer Science for All resource guide is a compilation of online and offline coding tools and curricula for students of all ages. Explore the resources here: y4y.ed.gov/computer-science.

Creative Computing
MIT Media Lab

"Creative computing" supports the development of personal connections to computing, by drawing upon creativity, imagination, and interests. This free guide provides 44 activities across seven units using the Scratch platform and is available in multiple languages. Download the guide here: scratched.gse.harvard.edu/guide.

CS Unplugged
CS Education Research Group at the University of Canterbury, New Zealand

CS Unplugged is a collection of free learning activities that teach computer science principles through engaging games and puzzles that use cards, string, crayons and lots of running around—no computer needed! The goal is for young students to dive head-first into computer science, experiencing the kinds of questions and challenges that computer scientists experience, but without having to learn programming first. Educator resources include a full set of videos demonstrating how to run activities and the solutions to each challenge. Access the activities here: csunplugged.org.

e-Textiles-in-a-Box
National Center for Women and Information Technology & the MIT High-Low Tech Group

Teach young people about electronics and computing with e-Textiles-in-a-Box! This guide provides instructions for sewing soft circuits and programming an Arduino microprocessor on the way to creating a bookmark book light and an interactive felt monster that lights up and sings. Get started here: www.ncwit.org/resources/e-textiles-box.

Family Creative Learning
MIT Media Lab

Family Creative Learning is a workshop series that engages children and their parents to learn together—as designers and inventors—through the use of creative technologies. Workshops are intended to strengthen the social support and expertise of families with limited access to resources and experiences around computing. Download the guide here: family.media.mit.edu.

Girls Who Code

Girls Who Code (GWC) allows for any afterschool program or other youth-serving organization to access their platform of curriculum and educator supports via their free Clubs program. GWC Clubs engage girls in grades six to 12 to use computer science to impact their community and join our sisterhood of supportive peers and role models. Clubs are led by Facilitators, who provided a number of supports including custom online training, weekly session guides, real-time support, and access to a national community of practice. Participating girls can also plug into other GWC initiatives like their free competitive-application summer immersion program for 10th and 11th grade students. Learn more here: girlswhocode.com/start-a-club.

Google CS First

Each CS First club is based on a real-world theme—like art, storytelling, and game design—to attract and engage students of varying backgrounds and interests. Themes provide about 10 hours' worth of lessons and activities, and students learn by watching videos on the computer and code using Scratch. CS First is targeted at student in grades 4 through 8 (or between the ages of 9 and 14). Educator supports include facilitator scripts, daily agendas, curriculum and other club materials, which are free and provided by Google. Register to start a club here: cs-first.com.

Hour of Code
Code.org

The Hour of Code is designed to be a quick one-hour introduction to get kids excited and interested in coding. Hour of Code events are often hosted during Computer Science Education Week, which takes place every year during December. However, you can use the tutorials at any time! Students can choose from several one-hour tutorials with fun themes like Star Wars, Minecraft, and Frozen. There are "unplugged" tutorials for those without access to computers or internet and tutorials available in multiple languages. Code.org has developed a "How-to" guide for afterschool educators, which includes a lesson plan template. Explore student courses and educator guides here: code.org.

ICT4me
Center for Technology in Learning at SRI International

ICT4me is an afterschool and summer curriculum for middle school youth to develop Information Communication and Technology (ICT) fluency, interest in mathematics, and knowledge of ICT careers. This problem-based curriculum capitalizes on youth interest in design and communication technologies. ICT4me provides structured interactions with ICT professionals, including having youth participate in engineering design and development teams. ICT4me provides facilitator guides, tips for recruiting and engaging youth, and more! Learn more here: ict4me.sri.com.

Kid-Friendly Programming Languages
Science Buddies

Science Buddies provides free project ideas and resources for students, parents, and educators. The Kid-Friendly Programming Languages guide outlines popular coding platforms for K-12 students and compares their difficulty level, compatible operating systems, and what they can be used for. Figure out what coding platform is best for your students here: www.sciencebuddies.org/science-fair-projects/project_ideas/CompSci_Kid_Programming.shtml.

Made with Code
Google

Made with Code is an online resource of coding projects to get teenage girls started with coding. The Made with Code uses a block coding platform that makes coding easy and accessible to those without a background in computer science. Made with Code projects include an emoji designer, a selfie "accessorizer," and a music mixer that use the block coding platform. Explore made with code projects here: madewithcode.com.

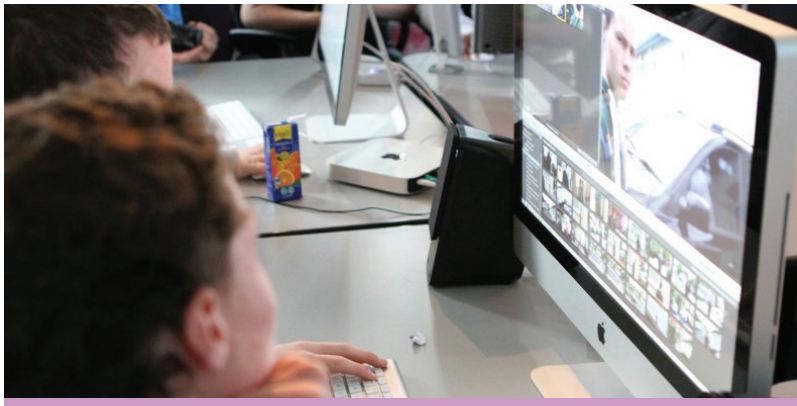


Photo courtesy of **The Clubhouse Network** *Boston, MA*

MIT App Inventor

MIT App Inventor is an online programming environment that teaches middle and high school students app design through an intuitive platform. Using block-based tools, a coding novice can have an app up and running in less than 30 minutes. We recommend checking out the associated curriculum from Youth Radio (Mobile Action Lab) and Iridescent Learning (Technovation Challenge). Explore the platform and resource here: explore.appinventor.mit.edu.

Project GUTS
Scheller Teacher Education Program at MIT

Project GUTS—Growing Up Thinking Scientifically—is an afterschool program where middle school students use computational thinking to design, create, and test computer models that answer questions about real-world concerns. Students use StarLogo TNG, a free graphical programming language for modeling and simulation. This platform and program are a bit more advanced. Though professional development workshops are not currently active nationally, the curriculum and leader resources are freely available. Explore them here: www.projectguts.org/AfterschoolClubResources.

ScratchJr
DevTech Research Group at Tufts University, the Lifelong Kindergarten Group at the MIT Media Lab, and the Playful Invention Company

ScratchJr is an introductory programming language designed for children ages 5 through 7. Kids program their own interactive stories and games, making characters move, dance, sing, and interact with their environment. ScratchJr was inspired by the Scratch programming language for ages 8 and up (scratch.mit.edu), but was redesigned to be developmentally appropriate for younger children. Download it here: www.scratchjr.org.

Photo courtesy of **The Thinkery** *Austin, TX*

Techbridge Girls

Techbridge Girls is a multi-city afterschool and summer program that inspires girls to discover a passion for technology, science, and engineering. In addition, Techbridge Girls produces high-quality curriculum and professional development, including units on Computer Science and Digital Media. While Techbridge is currently retooling these resources, be sure to check back for the re-release! Updated resources will be available here: www.techbridgegirls.org.

Thinkersmith

Thinkersmith is a non-profit dedicated to introducing youth to the fun, passionate, and creative side of computer science and computational thinking, with the goal of attracting and retaining non-traditional computer science students. While they are redeveloping their curriculum, two lessons are available free, and you can check out their collaboration with Code.org in producing the CS Fundamentals Unplugged. Download the Thinkersmith curricula here: thinkersmith.org/about-us/curriculum.

Tips for engaging girls and underrepresented students in computing

Just offering a computer science activity doesn't mean you'll get equitable participation among demographic groups. The National Center for Women and Information Technology (NCWIT) has several research-based resources to help.

1. **Top 10 Ways to Engage Underrepresented Students in Computing**: www.ncwit.org/top10engagestudents
2. **Top 10 Ways Families Can Encourage Girls' Interest in Computing:**
   - English: www.ncwit.org/top10families
   - Spanish: www.ncwit.org/top10familia
3. **Top 10 Ways to Increase Girls' Participation in Computing Competitions**: www.ncwit.org/top10computingcompetitions

Develop Your Skills and Connect with Others

Code Studio

While Code.org's K-5 curriculum was developed for in-school use, out-of-school time educators are welcome to attend the free in-person workshops that take place across the county. Find a local workshop here: code.org/professional-development-workshops.

ScratchEd

ScratchEd is an online community where Scratch educators share stories, exchange resources, ask questions, and find people. Sort resources by the "most bookmarked" to find some of the more well-developed submissions, like the Scratch Cards or the Design Studio Activities. ScratchEd is developed and supported by the Harvard Graduate School of Education. Join the discussion here: scratched.gse.harvard.edu.

CSforAll Consortium

The CSforAll Consortium is an online hub for the national Computer Science for All movement. The consortium provides anyone interested in computer science with resources to find providers, schools, funders, and research focused on providing computer science to all students. Become a member here: www.csforall.org.

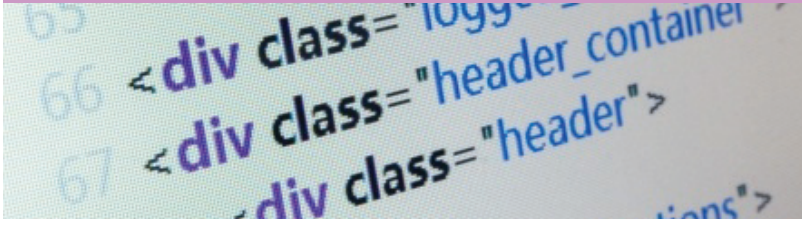
Scratch Educator Meetups

The ScratchEd Meetups Network is a project of the Creative Computing Lab at the Harvard Graduate School of Education. Scratch Educators who want to learn with and from each other and share their ideas can join or organize a meeting in their area. Find one here: meetups.gse.harvard.edu/index.html.

Bringing in outside expertise

Consider inviting local community members or tech professionals to help out. Not only can they provide content expertise, they can give your students valuable insight into professions in computer science and exposure to possible future career pathways. But, keep in mind that these experts don't necessarily have skills in facilitation or youth development, especially in an informal environment—Digital Corps in Pittsburgh, PA has some helpful findings on how to prepare these adults to successfully work with kids.

Photo courtesy of **The Clubhouse Network** *Boston, MA*



Standards for Computer Science and Technology

Schools, districts, and states might adopt or adapt subject matter standards in computer science and technology. Out-of-school time programs are not called upon to implement standards themselves, but should consider how to strategically relate to school day programming and standards, and position themselves as a partner in those efforts.

K–12 Computer Science Framework

A must-read for all stakeholders in computer science education, this framework provides the foundation for a complete computer science curriculum and its implementation at the K–12 level. Informal education, which includes afterschool and summer programs, is laid out as an essential part of the computer science learning ecosystem and included as a necessary partner within the implementation guidance (page 167). Thanks to the partnership between the Association for Computing Machinery, Code.org, the Computer Science Teachers Association, the Cyber Innovation Center, and the National Math + Science Initiative, the K-12 Computer Science Framework is available online, here: k12cs.org.

Next Generation Science Standards

The Next Generation Science Standards (NGSS) bring long-needed reforms to national and state K-12 science education standards, incorporating decades of new research on how students best learn science, and reflecting the many recent advances in knowledge made within the science disciplines. "Using Mathematics and Computational Thinking" is one of the eight core science and engineering practices that students develop competencies in across the gradespan. The development of NGSS was led by the National Research Council, National Science Teachers Association, American Association for the Advancement of Science, and Achieve, Inc. Learn more about the implications of NGSS for afterschool and summer programs here: www.afterschoolalliance.org/STEM-NGSS.cfm.

International Society for Technology Education Standards

The International Society for Technology Education (ISTE) Standards are a suite of standards for students, educators, administrators, technology coaches, and computer science educators that reflect a constantly-changing technological landscape. The ISTE Standards focus on providing students with the skills and environment needed to become life-long learners, solve the world's future problems, and develop important life and technology skills. Explore the standards here: www.iste.org/standards/standards.

Photo courtesy of **Project Guts** *Santa Fe, NM*

Grow Your Understanding

Here are a few key reading materials to help you understand the state of K-12 computing education in the U.S. Cite these stats in grant proposals to make the case for afterschool computer science!

Computer science K-8: Building a strong foundation
Computer Science Teachers Association (2012)

This document makes the case for computer science education for younger students, and includes a compendium of case studies to demonstrate the many ways computer science can be implemented with elementary and middle school students. Read it here: http://csta.hosting.acm.org/csta/csta/Curriculum/sub/CSK8.html.

Computer Science Education Research
Google (ongoing)

Google has commissioned several studies to gain a deeper understanding of how to increase student awareness and access to computer science. Recent papers include the state of computer science in K-12 schools; perceptions among students, parents, and educators; as well as a deeper dive into the structural and social barriers underrepresented groups face. Explore the research here: edu.google.com/resources/computerscience/research.

Girls in IT: The facts
National Center for Women & Information Technology (2012)

Girls in IT: The Facts is a synthesis of the existing literature on increasing girls' participation in computing. It provides a clearer and more coherent picture of the current state of affairs for girls in computing and the barriers they face. Read it here: www.ncwit.org/resources/girls-it-facts.

Growing computer science education in afterschool: Opportunities and challenges
Afterschool Alliance (2016)

This report summarizes a survey conducted of the afterschool field about their familiarity and interest in computer science, as well as the challenges to offering computer science. Read it here: http://afterschoolalliance.org/documents/Growing_Computer_Science_Education_2016.pdf.

How can you engage a diverse range of girls in technology?
Catherine Ashcraft & Elizabeth Eger (2015)

Culturally Responsive Computing programs help educators connect computing curriculum to the interests, prior experiences, and needs of students diverse in race, class, ability, and sexual orientation. This resource provides a research summary and case study of COMPUGIRLS, a summer, afterschool, and year-long program for girls in under-resourced school districts. Read it here: www.ncwit.org/resources/how-can-you-engage-diverse-range-girls-computing.

STEMtistics
Change the Equation (ongoing)

Change the Equation provides research and information on STEM education and the workforce. Their STEMtistics regularly translate the latest data into open access infographics. Find the computer science STEMtistics here: changetheequation.org/stemtistics/computer%20science.

Stuck in the shallow end: Education, race, and computing
Jane Margolis (2010)

This book looks at the daily experiences of students and teachers in computing in three Los Angeles public schools. Further, it explores how racial inequality is reproduced through our educational systems and how students and teachers can help change the system. Order it here: https://mitpress.mit.edu/books/stuck-shallow-end.

Women in IT: By the numbers
National Center for Women & Information Technology (2017)

The most compelling statistics on women's participation in IT on a single page. Download it here: www.ncwit.org/resources/numbers.

The Afterschool Alliance would like to thank the Symantec Foundation and the Silicon Valley Community Foundation for supporting our work in computer science education.

Symantec

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