Computer science professional development guide

How education leaders can build teacher, school counselor and administrator capacity to support equitable computer science education

Microsoft

Microsoft Philanthropies TEALS

CSforALL

CSTA Computer Science Teachers Association

national center for women & INFORMATION TECHNOLOGY

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Table of contents

3 Introduction

4 Step 1
Define your program's student learning objectives

6 Step 2
Match teachers with professional development that fits your goals and priorities

10 Step 3
Connect teachers with ongoing support

12 Step 4
Enlist and empower other supports

15 Resources

17 Contributing partners

Introduction

By 2026, there will be an estimated 3.5 million computing-related jobs open in the United States.[1] Today, 58 percent of all new jobs in STEM (science, technology, engineering and math) are in computing.[2] To fill these jobs, we need today's students to grow up not only using technology but also learning how it works and how to build, create and make an impact with it.

Broadly defined, the study of computer science (CS) teaches the science and art of using computers to solve problems. While coding and programming are certainly part of it, CS actually blends all the STEM subjects and teaches students a rich set of computational thinking, creativity and problem-solving skills. It engages students in a variety of activities, from robotics to design, and applies to every industry from healthcare to fashion.

However, three out of five schools in the U.S. do not offer computing courses that include programming or coding.[3] For them, a common barrier is a lack of teachers who feel confident that they can teach CS. Middle and high schools face the additional challenge of ensuring that the students who sign up for CS represent the demographics of the whole student population, including girls and students of color.

So whether your schools already offer CS or are just getting started, one of your top priorities will be getting your teachers, school counselors and administrators the additional experience, knowledge and resources they need to be effective computer science instructors and advocates.

This guide offers four simple but thorough steps that education leaders like you can take to build CS capacity among your K-12 teachers, counselors and administrators.

These steps align with best practices revealed and employed by university research and programs, as well as the insights and advice of many organizations leading the movement to bring quality CS education to all students: Code.org, the Computer Science Teachers Association (CSTA), CSforAll, Microsoft Philanthropies TEALS, the National Center for Women & Information Technology (NCWIT), the University of Oregon College of Education and the University of Texas at Austin's STEM Center.

A successful CS program is one where all students — across grade levels, gender, race and socioeconomic status — are represented in your CS classrooms and meeting comparable levels of achievement. Professional development is a key factor in making that happen in your school.

We hope you find this guide to CS professional development helpful. And we wish you and your staff the best in making CS education in your school equitable and effective.

1. By the Numbers. National Center for Women & Information Technology, 2018. www.ncwit.org/bythenumbers.
2. Employment Projections (table 1.2). U.S. Department of Labor, Bureau of Labor Statistics. 2016. https://www.bls.gov/emp/tables/emp-by-detailed-occupation.htm
3. Trends in the State of Computer Science in U.S. K-12 Schools. Google Inc. & Gallup Inc., 2016. www.goo.gl/j291E0

Step 1

Define your program's student learning objectives

A plan for professional development begins with establishing the student outcomes you desire for your program and, based on that, the curriculum your staff will be teaching. If you've already established your goals and curriculum, you can proceed to **Step 2**.

But if you're still in the early stages, you'll need to define your school's overall approach to CS. As with all the steps in this process, many organizations provide tools and guidance that can help.

Actions

☐ **Create a CS leadership team and meet with them to discuss your school's program, curriculum and overall philosophy.**

- This group should include administrators, school counselors and the teachers who will be teaching stand-alone CS courses or integrating CS with other subjects.
- Establish a shared commitment to a CS program where all students — across grade levels, gender, race and socioeconomic status — are represented in your CS classrooms and meeting comparable levels of achievement. Download the **Computer Science Recruitment Toolkit** that includes plug-and-play resources to help increase the diversity of students in middle and high school CS classes.
- Explore opportunities to make CS classes satisfy math or science graduation requirements. When schools "make computer science count" for graduation, enrollment and diversity both increase.

☐ **Get to know the CS learning and performance standards relevant to your state.**

- Identify whether your state has adopted CS standards and, if so, review those standards.
- Not every state has established standards for CS. The **Computer Science Teacher Association (CSTA)** has published **K-12 Computer Science Standards** that includes an interactive table that delineates student learning objectives by grade level, concept, sub-concept and practice.
- For many elementary schools, CS standards can be addressed interdisciplinarily and overlap with student standards in math and science.

> "When adding CS classes to your school, it has to be something that is good for all students, not just an add-on enrichment topic for those who are already benefiting from extra access."
>
> — Dr. Joanna Goode, Associate Professor, University of Oregon College of Education

Step 1

☐ **Work together with teachers to develop a curriculum based on your goals.**

- Gain an understanding of which courses the district offers or intends to offer across the K-12 space, how each course fits in the larger progression, and how they map to the CS standards you've identified.
- Many organizations provide curricula that you can adopt for your classrooms, and most of them offer professional development and support for teachers as well. See **Step 2** for details.

☐ **Commit to the ongoing assessment and growth of your CS program.**

- **CSforAll** has created **detailed rubrics** for this purpose, which you can use to evaluate your program's current state of development and clarify what you aim to achieve next.

School story: Making CS elementary

Five years ago, Frederick Douglass Elementary in Dallas, Texas, was looking for ways to close the wide achievement gap that existed between it and other schools in its district. Principal Marquetta Masters made it her mission to raise scores and empower her students by bringing CS into the school.

Masters went on to pilot an initiative, based on one being tested in her district's middle and high schools, in which an hour of CS is taught in every elementary grade, every week. In 2016, Frederick Douglass became the second elementary school in the nation to offer a comprehensive, school-wide computer science program, and was recently named a Public School Choice STEM Academy.

Math scores are now up 10 percent, and passing science scores have doubled. Even better, girls and boys are learning at a young age that computers — and confidence — are within reach for anyone who wants to try.

Get tips and tricks from Frederick Douglass Elementary's story **here**.

Step 2

Match teachers with professional development that fits your goals and priorities

Now that you've laid your foundation, you can start connecting teachers with the professional development opportunities that are right for your school and CS program. Consider the diversity of your student population and how you might develop a CS teaching staff that reflects that diversity. Since access and equity are critical elements of a successful CS program, make sure they're also a prominent focus of your teachers' professional development.

Also, keep in mind that professional development is most effective when it's ongoing and incremental rather than attempted in one heavy and isolated dose. And the best way to introduce CS to new instructors is through the same methods that work for students — hands-on experience, active learning and lessons applied to real-world scenarios.

Initial professional development

Initial professional development is about giving teachers a baseline understanding of CS lessons and teaching strategies, while also building their confidence and inspiring a growth mindset. Ideally, teachers will take action the summer before they begin teaching CS for the first time.

Actions

☐ **Take advantage of teacher-tested STEM and CS lessons and easy-entry learning opportunities.**

- The **Microsoft Educator Community** provides a personalized hub where teachers can find training and lessons, earn badges and certificates, and connect and collaborate with fellow educators.

☐ **Get to know the many professional development vendors and offerings you can choose from.**

- CSTA maintains a **list of providers** independently evaluated for a minimum level of quality, so that teachers can make value-based and cost-effective choices when determining which professional development experience is right for them.

Step 2

☐ **Consider programs that combine initial professional development and classroom curricula in one.**

- **Code.org** offers **professional learning workshops** for K-12 teachers new to CS. Teachers can learn Code.org's approach to teaching CS, design their own implementation plan, practice using Code.org's curriculum and build community with local educators.
- **Exploring Computer Science** has a **two-year program** that begins with a week-long summer institute immersing teachers in their curriculum. It continues quarterly throughout the school year and concludes with another week-long institute the following summer. The program's curriculum gives equity, CS concepts, and pedagogy equal weight.

> "Teachers are coming to CS from lots of different directions. So it's extremely important to give them options that they can select based on their background, knowledge and where they are in their journey."
>
> — Leigh Ann DeLyser, Co-Founder and Managing Partner, CSforALL

- **The University of Texas at Austin's STEM Center** offers a **variety of online courses** for K-12 teachers of all experience levels, plus a curriculum package designed for high schools.
- Microsoft Philanthropies **TEALS Co-Teaching model** pairs high school teachers with CS professionals who co-lead classes multiple times a week and provide curricula, lesson plans and lab ideas. This is a great way to support teachers as they learn a new subject area and provide students with a real-world expert and role model to help make the subject relatable.
- For teaching CS in an interdisciplinary setting, **Bootstrap** and **Project GUTS** both offer multi-day workshops. These give teachers an introduction to CS and its pedagogy and guidance on integrating Bootstrap or Project GUTS curricula into math and science subject areas.

☐ **Connect teachers with opportunities and information focused on creating and leading a diverse and equitable classroom.**

- **The National Center for Women & Information Technology's (NCWIT) EngageCSEdu** initiative provides **Engagement Practices** that teachers can use to broaden student participation in computing, including addressing misconceptions about the field and making interdisciplinary connections to CS.
- The University of Texas at Austin's STEM Center also offers **online courses** focused on equitable practices for supporting diverse students in computing.

Step 2

☐ **Show teachers the fun and creative side of CS by having them complete an Hour of Code activity on Code.org.**

- There are over 200 tutorials for all age and experience levels, focusing on a range of coding and other CS skills. Choose tutorials based on topic and many other filters.

Continued professional development

Continued professional development in CS gives teachers a deeper understanding of the subject and a wider array of skills and strategies to engage students in the classroom. Some CS teachers may be ready for continued professional development after one semester, but most will pursue it after they've taught CS for a year.

Actions

☐ **Enable teachers to attend a professional development conference.**

- CSTA's **annual conference** is one of the biggest networking and learning opportunities in the field. Attendees are treated to a wealth of workshops, sessions, keynote addresses, social events and more to enrich their knowledge and relationships with fellow teachers.
- The **International Society for Technology in Education (ISTE)** holds an **annual conference** where attendees can personalize their learning and create a custom professional development path.

☐ **Research certification opportunities for your teachers.**

- Find information about CS certifications and other policies in your state in **this document** compiled by Code.org.
- Because CS is a newer subject, with less established pathways to certification, **your regional CSTA chapter** is also a great resource.

☐ **Encourage experienced teachers to help with the initial professional development of new teachers.**

- This can be done within your own school or system, as more teachers begin leading CS classes, by providing formal and informal mentoring opportunities. Teachers can also apply to groups like **Code.org** to help facilitate the professional development programs they offer. Additionally, any teachers that participate in Exploring Computer Science's **two-year program** have the opportunity to be identified and mentored to become a facilitator.

Step 2

☐ **Provide teachers with support from industry volunteers through the Microsoft Philanthropies TEALS Classroom Enrichment model.**

- Teachers will lead their own classrooms while CS professionals support with labs and general advice.

School story: Helping teachers learn as they go

In the rural school district of Manson, Washington, Superintendent Matt Charlton had a hard time finding teachers with expertise in CS. So he looked outside the school — and found Microsoft Philanthropies TEALS.

With CS professionals who volunteer to team-teach classes remotely, Charlton's teachers learn the material alongside their students. Over the next two years, the volunteers will phase out and teachers will gradually take over teaching on their own.

But students are already seeing the benefits of having CS in their school. Microsoft Philanthropies TEALS volunteer Lester Jackson remarked, "I recall seeing three or four students that, under most circumstances, would not have gone to college. Our classroom alone sparked that interest so much that they enrolled and were accepted to college engineering programs."

Watch this **video** to learn more about this partnership and its effect on the Manson community.

Step 3

Connect teachers with ongoing support

CS teacher working groups and affiliations are an active and growing presence across the country. And they're among the best ways to provide new and experienced teachers with the ongoing learning and growth that is so important for their success. Connection to a community of practice provides CS teachers with essential support from peers who are on a similar path, as well as those who have been there before.

Actions

☐ **Bring together K-12 CS teachers from across your district to create your own teacher working group.**

- A local group enables teachers to share challenges and best practices within the context of your district's distinct culture and progression plans.

☐ **Encourage and support your teachers' memberships to the Computer Science Teachers Association (CSTA).**

- CSTA has more than 25,000 members from more than 145 countries. Members represent teachers from all school levels, as well as parents, education leaders, and government and industry representatives.
- Find a local chapter on CSTA's **regional chapters webpage**. If one doesn't exist in your area, **apply online** to get one started.
- Consider a **CSTA+** membership, which provides access to exclusive learning and teaching resources, continued professional development opportunities (see **Step 2**), classroom experiences and more.

☐ **Explore individual and group memberships to the International Society for Technology in Education (ISTE).**

- ISTE members have access to skill-building opportunities and content, including continued professional development opportunities with Code.org (see **Step 2**).

> "As they transition from other subjects, we're asking CS teachers to go through a pretty profound identity shift. It's essential we provide these communities of support so teachers feel ready to make that change."
>
> — Jake Baskin, Executive Director, CSTA

Step 3

☐ **Invite teachers to join the virtual community at CS for All Teachers.**

- The community has numerous online groups and channels for sharing knowledge and best practices.

> "Having a strong community to rely on is incredibly valuable, because your workshop facilitator won't always be around to support you. But your community will be."
>
> — Brook Osborne, Professional Learning Program Manager, Code.org

Step 4

Enlist and empower other supports

Teachers aren't the only ones who benefit from CS professional development. You and other administrative staff have a major part to play in making it more understandable, accessible and appealing to your students and wider community.

> "Equity is a key motivator for counselors. After all, if counselors are about anything, they're about creating opportunity – and helping students work toward their best futures."
>
> — Jane Krauss, Community Manager, NCWIT C4C

Professional development for counselors

Actions

☐ **Meet with your counselors to discuss their role in increasing student access to computing education and careers.**

- Use NCWIT Counselors for Computing's (C4C) **Top Ten Ways to Engage Counselors as Allies** as a guide. This resource provides a peek into the counselor role and offers ideas for partnering with them to make the composition of your CS classes map to the demographics of your school. Ideas include identifying and resolving systemic barriers that affect who takes and succeeds in CS, having female students drop by the counseling center to share what they like about computing and serve as an example to other girls, and more.

☐ **Show counselors the fun and creative side of CS by having them complete an Hour of Code activity on Code.org.**

- There are over 200 tutorials for all age and experience levels, focusing on a range of CS skills. Counselors can choose tutorials based on topic and many other filters.

☐ **Bring a Counselors for Computing (C4C) professional development workshop to your area, at no cost to participants.**

- Provided by NCWIT, C4C workshops range from one-hour webinars to two-and-a-half-day institutes. Counselors hear from experts, get exposed to coding firsthand and acquire presentations, posters, pathway cards and other resources they can use in their schools. Write to c4c@ncwit.org to get started.

Step 4

☐ **Connect counselors with tools to create equity and opportunity in CS classes.**

- Download the **Computer Science Recruitment Toolkit** co-authored by many organizations that contributed to this guide. Resources include a month-by-month checklist to ensure that CS class registration is promoted to the whole student population and a printable pamphlet about CS that counselors can share with students.
- Order a free NCWIT C4C **resource kit** for each of your counselors, which includes a Google Careers With Code magazine and a "Which CS Major Is Right for Me?" information sheet.

Professional development for administrators

Actions

☐ **Engage in some of the same steps teachers are going through in their professional development.**

- Taking part in some initial and continued professional development yourself (see **Step 2**) can help prepare you for what you'll see when you're supporting your teachers' growth in the classroom.

☐ **Participate in teacher working groups (see Step 3).**

- You don't have to join every meeting. But check in regularly to learn what teachers are trying to do in their classes, what they're struggling with, and how they're growing.

"Administrators shouldn't be afraid to get humble and learn new things right along with their teachers. It will only help the program and teachers when it's a team effort."

— Dr. Carol Fletcher, Deputy Director, the University of Texas at Austin's STEM Center

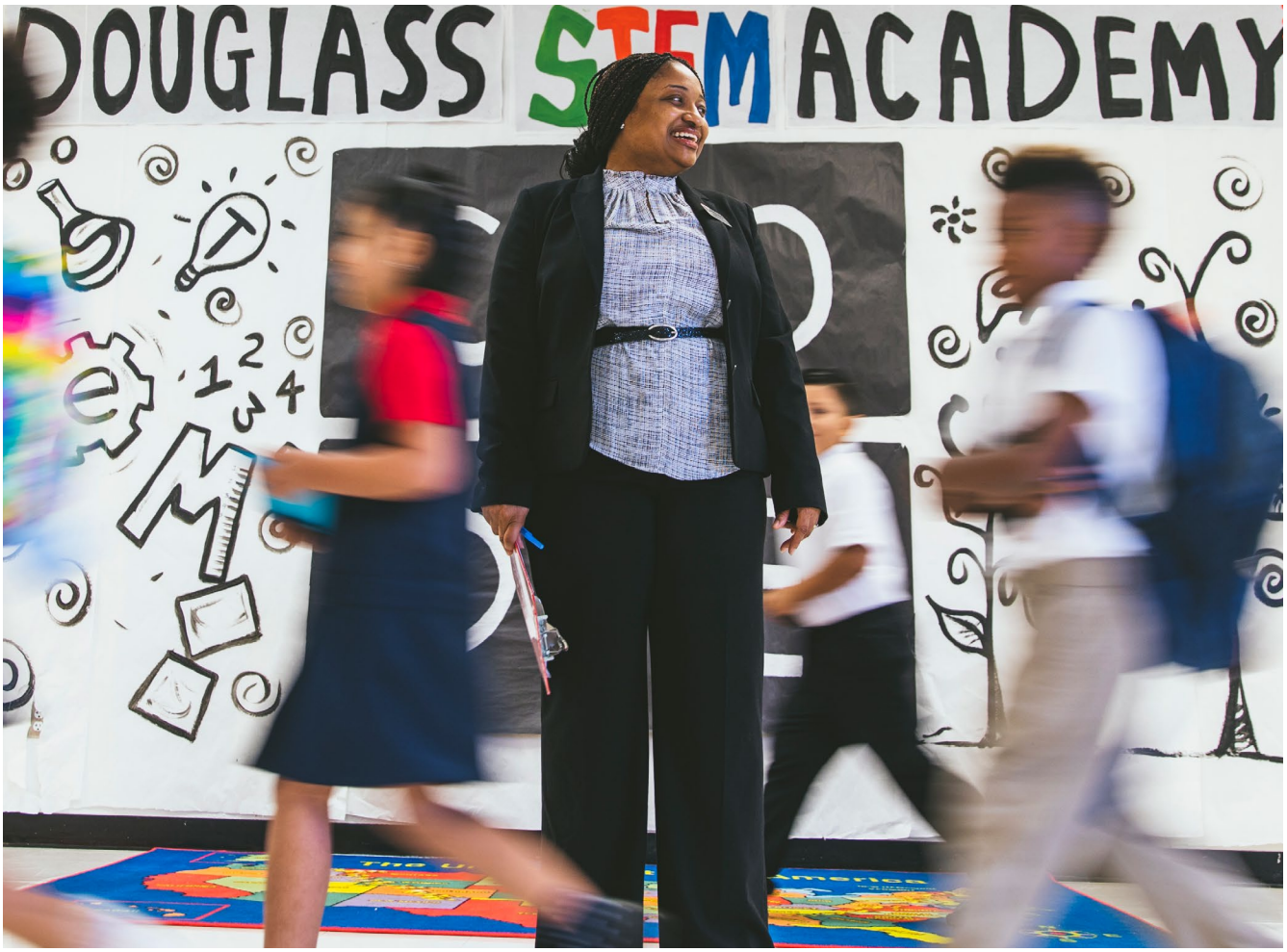
Step 4

☐ **Tour CS classrooms in other schools.**

- This is a good idea for everyone — teachers, counselors and leaders like yourself — and an easy way to widen your base of knowledge and build a local working group of CS educators (see **Step 3**).

☐ **Learn how to make enrollment in your CS classes reflect the demographics of your school as a whole.**

- Download the **Computer Science Recruitment Toolkit** co-authored by many organizations that contributed to this guide. It includes resources with information about increasing gender diversity in CS.
- NCWIT's **research** identifies promising practices for addressing the key barriers to increasing girls' participation in computing.
- The **Engagement Practices** provided by NCWIT's EngageCSEdu initiative are another good source of strategies for increasing diversity in computing.



Resources

For quick reference and people with hard copies of this guide, here is a master list of resources and links to help build capacity to introduce, teach and support CS in your schools.

Step 1: Define your program's student learning objectives

Computer Science Recruitment Toolkit from the co-authors of this guide: **www.bit.ly/2RVg32u**

K-12 Computer Science Standards by CSTA: **www.csteachers.org/page/standards**

Rubric to assess the current needs of your CS program: **www.csforall.org/script/**

Frederick Douglass Elementary case study: **www.microsoft.com/en-us/digital-skills/be-inspired/frederick-douglass-elementary**

Step 2: Match teachers with professional development that fits your goals and priorities

Professional development providers vetted by CSTA: **www.csteachers.org/page/CSPDmatrix**

Hour of Code activities on Code.org: **www.code.org/learn**

In-person professional learning workshops through Code.org: **www.code.org/educate/professional-learning**

Two-year professional development program through Exploring Computer Science: **www.exploringcs.org/for-teachers-districts**

Co-Teaching and Classroom Enrichment support models from Microsoft Philanthropies TEALS: **www.bit.ly/2J1bqQ0**

Online courses and curriculum through the University of Texas at Austin's STEM Center: **https://stemcenter.utexas.edu/online-education**

Multi-day professional development workshop through Bootstrap: **www.bootstrapworld.org/workshops/index.shtml**

Professional development programs through Project GUTS: **http://159.65.232.49/services-clients/**

NCWIT's EngageCSEdu initiative's teaching strategies for broadening participation in computing: **www.engage-csedu.org/engagement/make-it-matter**

CSTA's Annual Conference: **www.csteachers.org/page/2019conference**

ISTE's annual education technology conference: **www.iste.org/events/iste-events**

CS certifications and other policies in your state compiled by Code.org: **www.bit.ly/2CN4sxf**

Microsoft Educator Community: **https://education.microsoft.com/**

Pathway for teachers to become Code.org facilitators: **www.code.org/educate/professional-learning/facilitator**

Manson High School case study: **www.bit.ly/2OvMAOx**

Resources

Step 3: Connect teachers with ongoing support

List of local CSTA chapters:
www.csteachers.org/page/ChaptersbyRegion

CSTA+ memberships:
www.csteachers.org/page/cstaplus

Start your own local CSTA chapter:
www.bit.ly/2CM7anc

ISTE memberships: **www.iste.org/membership/become-a-member**

Virtual teacher community through CSforAll:
www.csforallteachers.org/

Step 4: Enlist and empower other support

NCWIT's C4C's top 10 ways to engage counselors as allies: **www.ncwit.org/counselorsasallies**

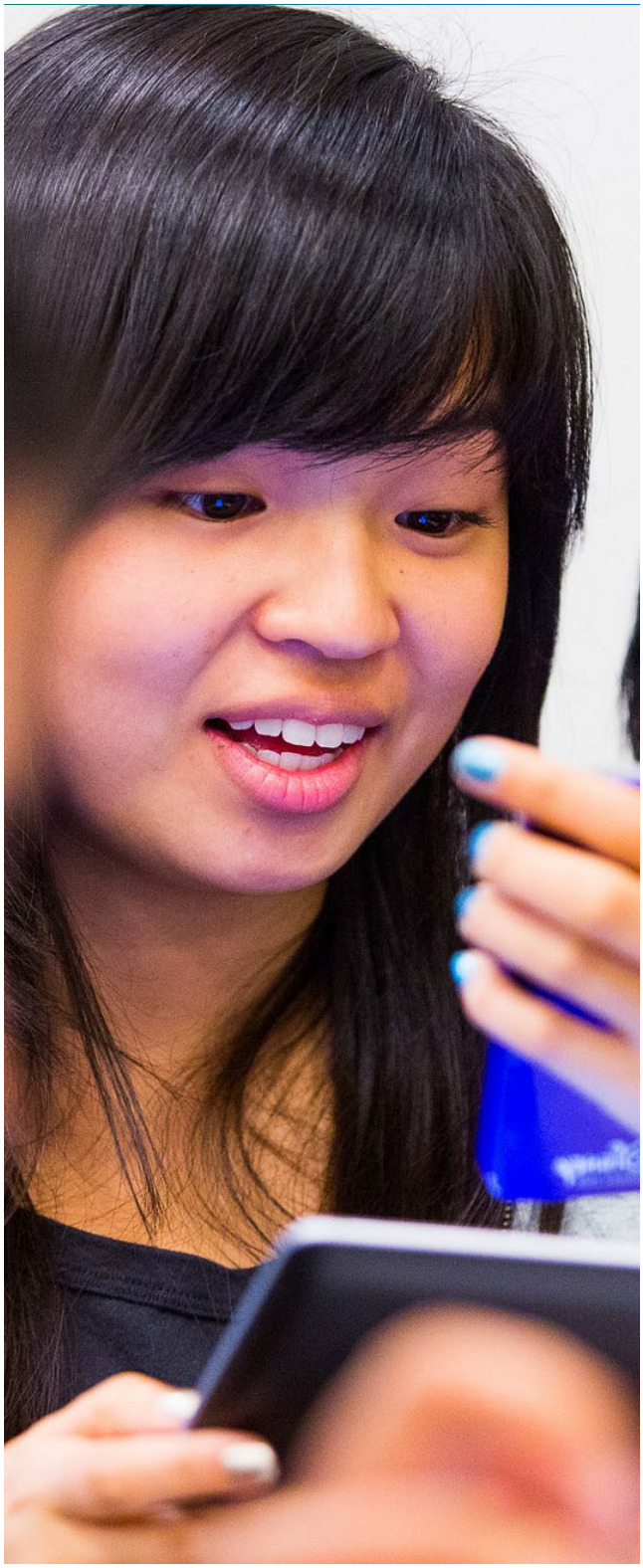
Hour of Code activities on Code.org:
https://code.org/learn

NCWIT C4C professional development workshops:
www.ncwit.org/project/counselors-computing-c4c

Computer Science Recruitment Toolkit from the co-authors of this guide: **www.bit.ly/2RVg32u**

NCWIT's research about increasing gender in CS:
www.ncwit.org/resources/girls-it-facts

NCWIT's EngageCSEdu initiative's engagement strategies for broadening participation in computing: **www.engage-csedu.org/engagement/make-it-matter**



Contributing partners

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Microsoft Philanthropies TEALS

Since 2009, Microsoft Philanthropies TEALS has helped hundreds of high schools across the United States build and grow sustainable CS programs. By pairing tech industry volunteers with classroom teachers, educators learn how to launch or expand CS courses for their students and help close the skills gap.

Learn more at **microsoft.com/teals**.

Microsoft Philanthropies

We're investing our greatest assets — our technology, people, grants and voice — to advance a more equitable world where the benefits of technology are accessible to everyone. Technology should be an equalizing force in the world, not one that drives people further apart. Through our philanthropic investments and partnerships, we are working to create a better future that everyone can share in.

Find more resources about computer science education, visit **microsoft.com/digital-skills**.

For information about Microsoft Education STEM and computer science programs and applications, visit **microsoft.com/education**.

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