4-H COMPUTER SCIENCE
PLAYBOOK

CODE

4-H
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Contents

Introduction

About 4-H

In 4-H, we believe in the power of young people. We see that every child has valuable strengths and real influence to improve the world around us. We are America's largest youth development organization—empowering nearly six million young people across the U.S. with the skills to lead for a lifetime.

Our Collaboration with Google

4-H and Google are coming together for a first-of-kind collaboration to bring important skills for the future, like computer science, problem solving, communication and collaboration, to kids across the country by establishing a 4-H CS (CS) Career Pathway.

Through a Google.org grant, 4-H will bring CS learning activities to kids throughout the nation equipping the next generation with the foundational skills they need to lead, innovate and problem-solve in every discipline—from business to fashion to agriculture. Google shares this vision and believes that all youth should have the opportunity to be creators—not just consumers—of technology.

At the core of our collaboration is this document, the 4-H CSPlaybook, which combines Google's background in CS education with 4-H's university research and youth-led model for learning. This Playbook allows you, as statewide and community educators, to deliver cutting-edge CS programming to kids in a way that fits your community's needs, while fostering leadership, confidence and life skills.

As 4-H works to Grow True Leaders, this program is critical for young people to be prepared for their future regardless of whether our kids find employment one day on a farm, in an art studio, or an office. We believe learning CS and adaptable skills like collaboration and problem-solving provides young people with the best possible opportunity to become leaders and innovators.

4-H Computer Science Playbook

The purpose of this Playbook is to provide elements of 4-H Positive Youth Development in tandem with the latest CS resources and activities. It also provides guidance for incorporating CS into various 4-H delivery modes or content areas, and may serve as a blueprint for 4-H educators, volunteers and teen leaders to integrate CS into any aspect of the 4-H experience.

A Playbook is a book put together by a coaching staff, to provide team members instructions for the various plays to be used in "the game." In this case, the goal of the game is to provide youth with meaningful CS experiences. Like football, CSeducation experiences are best designed with a variety of play options. As you utilize the 4-H CSPlaybook, think about your current situation, resources and desired short- and long-term outcomes. Additionally, "Playbook Coach Tips" woven throughout the guide will give you tips and guiding questions to make the most of the resource.

The Playbook is not a curriculum or a comprehensive guide. Instead, it is a quick start guide to gain some basic understanding of the 4-H CSPathway and how these concepts, resources and activities can be a part of a larger 4-H program.

What is Computer Science and Computational Thinking?

Like many technical fields, CS involves a lot of terminology, most of which is helpful but some of which is confusing. Perhaps the easiest place to start is with CS itself. CS is the study of computers and algorithms (sets of instructions that computers can interpret and carry out) including their principles, their hardware and software design, their applications, and their impact on society. Programming (often referred to a "coding") is the act of writing instructions (algorithms) using a programming language. For example, a programmer may write a program (a series of algorithms) that instructs a robot how to move in a specific pattern or instructs a computer to review millions of pieces of data to identify a specific image.

Programming/coding, however, is just a part of the process, as computer scientists also need to understand a problem (what are its components), understand the user (what do they need), design a solution (determine a possible way to solve it), develop a solution (write a program or series of programs), test the solution (try it out and make sure it works properly in all possible cases), and often continue to maintain (adjust) the program over time. (Tucker, A., McCowan, D., Deek, F., Stephenson, C., Jones, J., & Verno, A. (2006). A model curriculum for K–12 computer)

As the field of CS has continued to develop, the processes described above have led to a new way of thinking about and solving problems. This type of problem solving is called "computational thinking" and it involves thinking about a problem in a way that can be solved using the power of computing. The beauty of computational thinking is that it allows the user to apply the powerful tools of computing to problems. Computational thinking includes:

- problem decomposition (breaking a large problem into smaller solvable subproblems),

- abstraction (representing essential features without including the background details),

- algorithms,

- pattern recognition,

- data collection and analysis, and

- modeling and simulation

The power of computational thinking is not just that it can be used to solve problems in almost any area, but that it also helps those who use it develop skills that will serve them in all aspects of their lives. These skills include:

- Confidence in dealing with complexity

- Persistence in working with difficult problems

- Ability to handle ambiguity

- Ability to deal with open-ended problems
- Working with others to achieve a common goal or solution
- Knowing one's own strengths and weaknesses

PLAYBOOK COACH TIP

Computational thinking may be a new concept to use in your teaching. The great thing is these skills are transferable to a variety of situations. In fact, many 4-H experiences all ready use parts of computational thinking. Consider a 4-H quick meal contest, 4-H youth are presented with a problem, to cook an entire meal in a short time period. How do youth decompose the problem into smaller problems to solve? For youth involved in a 4-H Horse Project, the trail class is an model of obstacles that could be encountered by an equestrian on the trail.

Look at which CT concepts are present across the set of activities you do. Use those common elements to reinforce concepts and draw connections across activities." For more information about computational thinking, and how this topic can be incorporated into a 4-H program visit this link for a CT learning guide. http://bit.ly/2NRJOyv

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The 4-H Experience

The 4-H Experience

4-H is the ideal vehicle to introduce youth to CS activities through after school programs, summer camps, maker camps, clubs, county fairs and through partnerships with business and community leaders. The reach of 4-H is nationwide, diverse, and also provides resources for clubs and groups to choose their own CS-related project areas to study, learn, create and master. Pairing good CS content with the quality youth development structure allows to create learning with high content value within the context of a program that provides youth with an optimal environment to experience computer science.

4-H Essential Elements

In the 4-H Program, the critical components of a successful learning experience are a sense of Belonging, Independence, Mastery, and Generosity. CS can provide opportunities to put the Essential Elements into practice.

Belonging: Create a safe and inclusive environment and foster a positive relationship with youth learners. CS programs can provide a learning environment that youth interested in the topic may be drawn to to be with other youth who are interested in similar topics.

Independence: Youth need to know that they are able to influence people and events through decision-making and action. These programs can present problems to solve and the opportunity to learn new skills to assist in problem solving.

Mastery: In order to develop self-confidence youth need to feel and believe they are capable and they must experience success at solving problems and meeting challenges. CS allows youth the opportunity to be successful in a variety of projects, completing a code challenge or soldering a programmable game are examples of how youth can be successful.

Generosity: Youth need to feel their lives have meaning and purpose. Community service can come in many forms. Designing an app that addresses a community issue or teaching others can provide experiences to demonstrate Generosity.

Additional information about the 4-H Essential Elements can be found here: 4-h.org/wp-content/uploads/2016/02/TheEssentialElementsof4HYouthDevelopment.pdf

4-H Science Abilities

4-H has identified 30 Science Abilities that can help youth to think and act like scientists. As we facilitate CS activities, we help youth develop those same abilities. These abilities assist youth to become better at skills like observation, interpretation, problem solving, communication and more. Skills which can lead to personal success in a future science and engineering activities, and apply to any career. Encourage facilitators and youth to actively use the STEM abilities as they do CS activities, as they reflect on the CS activity and then encourage discussion of how the STEM ability could be applied to a new situation that the youth may encounter.

Locations have had success in printing out the STEM Abilities and placing them around the learning space to assist leaders and youth in remembering and using the STEM ability to express the kind of action they are completing. You may also consider providing cards with the 4-H Pledge and STEM Abilities on a lanyard to leaders to reference quickly as they teach. For example when working in a group "ask the youth to collaborate to begin problem solving" or if a program doesn't work the first time, ask "How might we troubleshoot to identify the problem and redesign to solve the problem?"

Texas 4-H has listed the Science Abilities and provided examples of how these abilities can be incorporated into many 4-H projects: https://texas4-h.tamu.edu/wp-content/uploads/projects_science_SET_abilities_11.pdf

PLAYBOOK COACH TIP

When discussing 4-H it is important to describe the leadership and life skills that 4-H members develop through involvement in the program. Throughout the experience, encourage the use of the experiential learning model "Do, Reflect and Apply" to be intentional to develop the leadership and life skills of the youth you work with. More information about the Experiential Learning Model can be found here: http://bit.ly/2oMd1jp

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First Steps in Starting
a CS Program

First Steps in Starting a 4-H CS Program

CS can be a rewarding endeavor for a 4-H Program. For many, working with CS and computational thinking projects and concepts will be new and can be intimidating. Utilizing the Playbook allows you to learn the experiences of 4-H youth, volunteers, staff and faculty to craft programs that work for a variety of 4-H programs.

A helpful tool to visualize a 4-H CS Program is the 4-H Career Pathway. It is designed to translate abstract CS concepts into more appealing, practical experiences that help young people explore and prepare for CS in the real world. The four components of the Pathway—Explore, Learn, Practice and Experience—provide intentional and progressive CS education and leadership skills for youth of all ages.

The 4-H Career Pathway

Explore

"I might like to do this."
Activities that spark an interest through intro, short-term CS projects, ranging from 1-5 hours. Activities attract underserved and minority youth who may not (yet) see their potential in STEM.

Content:
4-H National Youth Science Day, Hour of Code, Farm Field Day bringing kids to working farm or fairground event booth at fairs.

Outcome:
Interest in technology and/or directly coding.

Learn

"I'm interested in this"
Project-based learning to improve understanding of a topic, develop problem-solving and collaboration skills. Long-term experiences ranging from 6-30 hours

Content:
Code club programming, such as CS First, camps focused on CS activities and clubs like 4-H Robotics Clubs cross-over content.

Outcome:
Confidence and seeing oneself being successful in this.

Practice

"I can do this."
Rigorous projects designed to build technical and leadership skills. Sustained and immersive learning of 31+ hours.

Content:
Community Action Plans, Hack-a-Thons or Design Challenges, Teaching Younger Youth.

Outcome:
Skill building success and demonstrating mastery

Experience

"I will be this."
Real-world applications with tech gurus, Google employees, etc. help youth prepare for and gain confidence in a particular field of interest (50+ hours).

Content:
Job Shadowing, Internships, Career Days, App Development

Outcome:
College and career readiness

- In the Explore stage, youth participate in introductory, short-term CS experiences to spark curiosity and interest.

- In the Learn stage, youth delve into projects that teach more advanced CS concepts and problem-solving skills.

- During Practice, youth engage in more long-term projects with professional/volunteer coaches to guide them in building CS and leadership skills for college and their careers.

- During the Experience stage, youth can immerse themselves in a field of work, including on-site training, shadowing and internship opportunities with CS related businesses. Also intern with local community serving organizations who may benefit from technical help.

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Type of 4-H Programs	Possible CS Activities	Part of the Pathway
Fair Booth or Event Table	Simple Unplugged Activity, Makey Makey	Explore
Camp standalone CS topic	CS First, Unplugged Activity, Google Expedition	Learn
Activity integrate into a larger camp event	Google Logo Activity, Unplugged Activity, Google Expedition (tied to camp theme)	Learn
4-H SPIN Club	CS First, Unplugged Activity	Learn
4-H Project Club Integration	App Inventor, e-textiles, Learning Game	Learn
4-H Teen Leaders	Leading CS First Clubs, Camp Activities, Fair booth, Tech Team	Practice
4-H CS Depth Projects	Internship, MOOCs	Experience

PLAYBOOK COACH TIP

The 4-H Career Pathway is an effective tool to use when making a long-term plan for your 4-H CS program. What elements of the career pathway might exist in your county that you might be able to incorporate CSinto? For example a farm field day that could include "farm tech" or a summer day camp series that could include a CS topic.

Brainstorm Activity

Consider the following questions when utilizing the Career Pathway to begin to brainstorm a potential CS Program.

Who: Who is the target audience for the 4-H CS program? Different age groups have different skills and interests. CS programs can provide a variety of options for various age groups. Additional audiences to consider are potential leaders and volunteers, who may have a range of skills and come in the form of afterschool staff, parents, 4-H club leaders, CS professionals, college faculty, and students and teens serving as leaders.

4-H programs have engaged a variety of audiences. Examples include an introductory program like CS First, csfirst.withgoogle.com, to accommodate younger youth who are learning the basics or utilizing the Discover 4-H Python Code Club Guide, utah4h.org/discover, to provide experiences for older youth with more CS experience. Additionally 4-H programs have introduced CS concepts to youth involved in a 4-H Horse Club program by developing apps to aid in learning equestrian concepts.

What: 4-H CS programs can take many forms. Finding the types of program delivery that work best for a 4-H program is essential to success. CS content can be a standalone topic for camps and clubs or can be infused into other 4-H program offerings. Successful 4-H CS programs can be found using a variety of delivery modes. Examples include a weekly Code Club, an all night Hackathon event or a CS Summer Camp. These programs chose from a variety of resources that are found in the Playbook. Making apps

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through MIT's App Inventor, appinventor.mit.edu/explore was an engaging project for a weeklong summer camp program.

When: A flexible program allows youth development professionals and volunteers to select a timeframe that works best for their local program. The following are a few suggested options: a one-time event, an extended afterschool program, a summer camp, day camp or weekend retreat. Match the program offering with the time frame that works best. A 4-H Coding Club found that that the ideal team for their meetings was once a week late afternoon based on the availability of a university computer lab, and the volunteer college students and professor.

Where: Libraries, community centers, schools, college/university labs and other locations that provide space for youth to gather to learn are good location options. Considerations for CS programs may include: are there computers in the space that youth can use? What is the Wi-Fi capacity if using a mobile laptop or tablet lab? Is there space to provide for additional learning activities that may require tables and chairs or open space?

Camp facilities, parks and open spaces can be utilized as well for CS. These spaces are excellent to allow for enough space for unplugged CS activities that may involve running relays or other activities that require open spaces.

4-H Clubs involved in Citizen Science can utilize a variety of apps to collect, record and then review data. A club involved in Water Quality Monitoring can use this program in the field to assist them in recording data that can then be compared and analyzed. www.citsci.org

Why: Ask what the program plans to accomplish through the CS effort. Defining the "why" will allow for the creation of a program plan that works towards an end goal. Youth groups have found success in defining their "why" in a variety of ways: increasing CS literacy, building specific skills youth looking to learn how to code in Python or projects using microcontrollers to operate a custom LED lantern light sequence.

How: The Playbook is a tool to help answer the "How." Consider the many options and resources in the Playbook

PLAYBOOK COACH TIP

Thinking through the Who, What, When, Why and How at the beginning of the Playbook will assist you applying the resources in the Playbook. Don't get discouraged if you find you don't have all of the resources you would like to start. Start small and begin the building process. Begin the brainstorming process below by brainstorming the 5 W's and H.

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Implementing a CS Program by Delivery Mode

Implementing CS by 4-H Delivery Mode

There are many delivery modes already in place throughout the 4-H program that provide a great opportunity to infuse CS related activities. 4-H programs have implemented CS at camps, large regional and state 4-H gatherings, after-school, and tabletop/make-and-take activities at county fairs or other public events. As you review the delivery modes, consider which kinds are used in your program. Many groups have found success in implementing CS at a local level using two strategies:

1. Developing standalone CS events, clubs and camps that have a theme/focus on computer science

2. Infusing CS activities and concepts into other events, clubs and camps

Community 4-H Club

CS may be a learning experience that youth in a 4-H Community Club choose to explore. Clubs may choose from a variety of 4-H Curriculum options, utilize a CS Unplugged activity or may choose to participate in a shorter-term activity like Hour of Code, code.org.

Project 4-H Club

CShas enough content and depth that youth and volunteers may choose to focus on throughout an entire year. Clubs may choose from a variety of 4-H Curriculum options, a series of CS First club modules or may choose to enroll in a massive open, online course (MOOC). Youth have found the structure of the project club allows them to collaborate and support each club member's learning goals.

4-H SPIN Club (Special Interest Club)

A 4-H SPIN club is a special interest club where five or more young people learn about a topic of interest. Topics vary and include interests, such as nature, heritage arts, science, engineering, gardening, technology and more. SPIN clubs are led by volunteers who have a passion and want to share their knowledge with young people. The "Discover 4-H Beginning Code Club" Guide provides six club meeting

activities to allow youth to learn the basics of computer coding or CS First provides an excellent club structure and teaching resources for a SPIN club.

In-School 4-H Club

4-H Programs have found that CS First provides the structure and learning resources to support an in-school 4-H Club. The National Youth Science Day "Code Your World" is also an excellent resource.

Military 4-H Club

CScan be incorporated into a Military 4-H Club using similar resources CS First. These resources can be used in a club at the youth center clubs or geographically dispersed clubs.

4-H Afterschool Programs

Afterschool programs vary significantly in the amount of time they can devote to a CS effort. Depending on the time, facilities and equipment available, programs can choose CS Unplugged Activities, CS First, Discover 4-H or Hour of Code activities.

4-H Camping

Day camps and residential camps have been utilized by 4-H programs to engage youth in CS. Programs have been successful in running camps that utilize CS as an overall theme for the camp and its activities. Camps have also been successful in utilizing CS as part of a larger camp experience using introductory, computer based activities as well as unplugged activities to teach a concept. Summer camps can be tailored to new beginners, intermediate and advanced concepts.

PLAYBOOK COACH TIP

4-H has developed various delivery modes to accommodate a variety of learning environments. Similarly, there are a variety of CS resources that can be utilized. Careful pairing of the delivery mode and the program resource are essential to ensure a successful experience.

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# Implementing a CS Program by 4-H Project Area

Implementation by 4-H Project Area

Creating CS specific clubs and interest areas is an excellent goal for a 4-H program. Introducing youth to CS topics and activities is the first step to achieving this goal. The 4-H program includes many clubs and areas of interest that are not traditionally CS-related but could be used as avenues to spark curiosity, interest and hopefully passion. Listed below are a few traditional clubs and examples of how CS activities could be incorporated.

Sewing Clubs

CS technology can be easily introduced into 4-H sewing clubs through e-textile applications. E-textiles are projects created using fabric with embedded electronics including sensors, lights, motors and small programmable computers. A great video that demonstrates the theory and application can be found at www.ncwit.org/video/e-textiles.
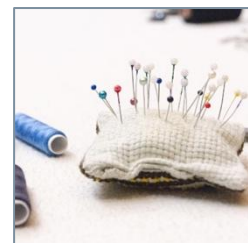
Following are links to patterns, tutorials or kits to e-textile projects:

- LilyTiny Plush Monster: learn.sparkfun.com/tutorials/lilytiny-plush-monster

- LED Stuffed Monster: alumni.media.mit.edu/~emme/monsters.pdf

- E-textiles in a Box – Interactive Stuffed Monster: ncwit.org/sites/default/files/resources/etextiles_box_0.pdf

- Sew Electric – Interactive Stuffed Monster: http://sewelectric.org/diy-projects/interactive-stuffed-monster/

- Led Bookmark Book Light: sewelectric.org/diy-projects/bookmark-book-light/

- Fabric Piano: sewelectric.org/diy-projects/5-fabric-piano/

- Wearable Electronics Class: instructables.com/class/Wearable-Electronics-Class/

- 4-H NYSD 2017 kits - Incredible Wearables: shop4-h.org/products/2017-national-youth-science-day-kit?_ga=2.235967496.821881146.1493830864-379625358.1493830864

Maker Clubs

Maker clubs and camps use a "learn by doing" approach to create projects. These projects teach skills, allow for trial and error, build confidence and teach the youth to problem solve. There are seemingly unlimited resources available for things to make. The following are a few tried and true ideas that incorporate CS technology:
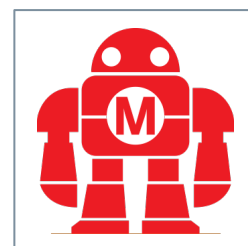
- Zen Laser Cut Lantern-learn to design and cut on a laser cutter instructables.com/id/Laser-Cut-Paper-Lantern/

- LEGO EV3 Robots – Campers and club members utilize robotics to learn about basic parts and sensors, build and program. ego.com/en-us/mindstorms/about-ev3

- Makey Makey Banana Piano

- librarymakers.net/piano-keyboard-makey-makey

Financial Literacy Clubs

Financial literacy clubs can incorporate coding activities to promote and teach money management, savings, budgeting, etc.

- Scratch Quiz Game: students learn CS principles and develop their own game to encourage youth to practice good money management principles. Sixteen-year-old Madison Adamson created a game and says the program has helped her in her goals and she hopes her game will be able to help others understand financial management.

Media/Digital Clubs

Create music, synthesize sounds and learn to add pizazz to games, applications, videos and more. The following are some learning resources:

- Made with Code Music Mixer – madewithcode.com/projects/music

- Made with Code – Beatsmadewithcode.com/projects/beats

- Tynker Music Video – www.tynker.com/ide/embedded?dir=launchplayer%3Fp%3D56182398af923139258b4574&c=setup

- Sonic-Pi – http://sonic-pi.net/

Cooking Clubs

Incorporate the love of cooking into the world of CS by exploring how automated robots prepare food and meals. Teach beginning Scratch programming and use their new coding skills to solve problems and automate repetitive tasks. Videos that may spark an interest are as follows:

- staubli.com/en/robotics/robot-solution-application/food-robot/

- 2015.dlg.org/fileadmin/downloads/food/Expertenwissen/Lebensmitteltechnologie/e_2015_1_Expertenwissen_Robots.pdf
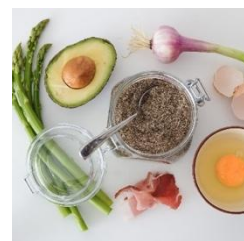
Agriculture Science Clubs

Introduce CS to the world of agriculture by using sensors and exploring ways to automate watering and fertilizing schedules. Prepare algorithms of frost dates, heat cycles and rain patterns to optimize planting and harvesting times. The following link has excellent information about how mixed reality and machine learning are driving innovation in farming:

- techcrunch.com/2016/11/17/how-mixed-reality-and-machine-learning-are-driving-innovation-in-farming/
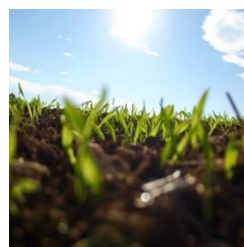
PLAYBOOK COACH TIP

Creating CS specific clubs and interest areas is one of the goals of this playbook. An additional goal is to engage the 4-H system in a larger, intentional way towards CS. Introducing youth to CS topics and

activities is the first step to achieving this goal. The 4-H program includes many clubs and areas of interest that are not traditionally CS-related but could be used as avenues to spark curiosity, interest, and hopefully passion. How can your 4-H program develop a plan to foster the growth of new CS clubs and introduce CS and computational thinking into existing 4-H clubs and activities?

Standalone Events

Standalone Computer Science Events

An effective way to engage new partners and start getting involved in CSis to participate in a CSevent. The following are examples of CS programs and activities from across the country. These events have potential partners, existing promotion and teaching materials and may allow a 4-H Club to be part of something larger than they can do on their own. These examples show that programs and activities can be diverse and are not one size fits all. Many curricula can be easily adapted for age appropriate activities.

National Youth Science Day 4-h.org/parents/national-youth-science-day

4-H National Youth Science Day (NYSD) is the world's largest youth-led science experiment. Every year thousands of youth take part in the NYSD challenge focusing on important STEM topics and issues. Local NYSD events are held throughout the month of October and are perfect opportunities to introduce 4-H youth to a CS-related project. Watch Shop 4-H to order kits. shop4-h.org International Scratch Day day.scratch.mit.edu/host

Many 4-H Clubs use the resources provided online for Scratch Days, which inspire youth to make and share creative projects. Scratch Days can be large or small, for beginners and for more experienced Scratchers. You can host your own event anywhere people can gather, such as at a school, library, museum, business or at home. A computer lab onsite or the ability to set up computers and have internet access is required.

Most Scratch days are celebrated in May, but events can be coordinated at any time.

Computer Science Education Week csedweek.org

The Hour of Code is a global movement reaching tens of millions of students in 180+ countries. Anyone, anywhere can organize an Hour of Code event. One-hour tutorials are available in over 45 languages. No experience is needed. Guided activities engage youth and adult participants with materials designed for ages 4-104.

Hackathon

A hackathon, also known as a hack day, hackfest or codefest is a design sprint-like, competition event, usually hosted by a tech company, university, or organization where programmers get together for a short period of time to collaborate on a project. The event usually lasts 24-48 hrs. These competition-style

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events have participants build prototypes of software applications like web or mobile apps. These events are on the rise and represent a new opportunity for 4-H to get involved in an existing event or develop their own. An example of 4-H being involved in a hackathon is the Washington County 4-H Program assisting in the planning and execution of the Southern Utah Code Camp.

southernutahcodecamp.com/about – Code Camp is a programming, design, and entrepreneurship contest all rolled up into a ridiculously compressed 24-hour event. Teams ranging in size from one to four participants compete against other teams to build the best web or mobile app. The 2016 event featured four divisions:

- Industry teams who compete to develop company ideas and claim bragging rights

- Collegiate teams who want to impress potential employers

- Novice teams who are exploring the industry and learning new techniques

- Rookie Kit teams who are exploring the industry and want to base their project on the provided rookie kit southernutahcodecamp.com/rookie-kit

The first code camp was in 2010. Since then, an active board of volunteers has evolved Code Camp into a highly-anticipated, sponsor-funded event that is gaining both popularity and recognition across the region.

The Washington County Utah 4-H program plays an active hand in the organization, marketing, and execution of this event. The 2017 event capped out at an astounding 186 participants. 74 of those registered were 4-H members and the winners in both the Novice and Rookie team divisions have consistently been dominated by 4-H youth.

County Fair

The County Fair provides a capstone for many 4-H youth and their projects. CSprojects can fit into the indoor fair exhibits amongst the more traditional 4-H projects. Fairs usually coincide with the end of the school/club year and are the perfect opportunity for youth to finalize designs, showcase projects and earn motivational awards for their efforts. Projects created at summer camps and afterschool programs should also be kept in mind for entry as well. The following are ways to incorporate CS projects into county fairs:

- University of Illinois Extension has developed a variety of categories where youth can enter their CS projects in the county fair. Follow the link for more information: 4h.extension.illinois.edu/members/projects/computer-science

- Computer Science Fair Judging Sheet: 4h.extension.illinois.edu/sites/4h.extension.illinois.edu/files/projects/documents/STEM/computer-science-judging-score-sheet-2015.pdf

- Plan a show and tell activity for youth to present their project entries to judges at the county fair and make it open to spectators.

- Have a "Maker" booth in the exhibition area of the county fair where teen leaders/mentors can teach youth attendees about soldering, circuits and basic programming while creating a simple project. This helps peak interest in both CS and the 4-H Program.

- Use Google Expedition kits as a booth activity to delve into augmented reality and get youth excited to go deeper into CS. edu.google.com/expeditions

CS Curriculum
and Resources

CS Curriculum and Resources

Many resources have been developed to teach youth computer programming and CS. Using resources that already exist gives leaders a place to begin developing their own CS programs. These programs can later be customized to meet the needs of their individual groups or clubs. The following are a few resources that are currently available, easily accessible, and have been developed to peak the curiosity of youth of all ages while teaching valuable CS skills.

PLAYBOOK COACH TIP

At the beginning of the CS Playbook, you identified the Who, What, When, Where, Why and How of your potential CS program. Now is a good time to look back at that list to determine what resources will help you develop the plays you would like to run in your given situation. As you look at the resources questions to consider include:

- Is the resource appropriate for the age and skill level of the youth the program will serve?

- Are the volunteers that will be facilitating events able to access this resource? How might I help them get the resources they need?

- Does this resource align to the intended outcomes of the program?

- What resource is appealing to the demographic of the target audience?

- Does the timeframe I have (ie, club meeting, after-school program day camp etc.) allow for enough time to utilize this resource?

- Does this resource require any specific physical space requirements (e.g. tables/chairs, large space to run around in, internet connections?

- Does the resource require equipment ex computers, tablets, or headphones, or wifi/internet

- Why is this the best resource for my intended outcome?

- How can I find the people, equipment or space to run the program?

- How can I help caring adults and teen leaders to be successful in delivering this program?

CS Teaching Resources

4-H Curriculum

Discover the treasures of information included in each of the 4-H Curriculum books. These publications are designed to walk club leaders and members through the basics of starting a CS club, providing meaningful learning experiences and project ideas that are sure to peak interest.

Discover 4-H

The Discover 4-H Clubs series guides new 4-H volunteer leaders through the process of starting a 4-H club or provides a guideline for seasoned volunteer leaders to try a new project area. Each guide outlines everything needed to organize a club and hold the first six club meetings related to a specific project area. The six club guides are: Discover - 4-H Code Clubs (for beginner, Grades K-8), Discover - 4-H Scratch Code Clubs (for intermediate coders ages 9-14, Discover - Makey Makey Clubs (for intermediate coders ages 9-14), Discover - 4-H Python code Clubs (for advanced coders grades 9-12), Discover - 4-H Robotics Clubs (for beginner, Grades K-8) and Discover EV3 Robotics Clubs (for intermediate coders

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ages 9-14. The publications can be found online at: utah4h.org/discover

Discovering Computer Science & Programming through Scratch: Level 1 Youth Guide

This curriculum introduces young people to five fundamental principles of computer programming, providing a foundation for exploring and creating. Scratch is a project of the Lifelong Kindergarten Group at the MIT Media Lab. Each youth in a group should have his or her own guidebook. shop4-h.org/products/discovering-computer-science-programming-curriculum-youth-guidehttps://shop4-h.org/products/discovering-computer-science-programming-curriculum-youth-guide
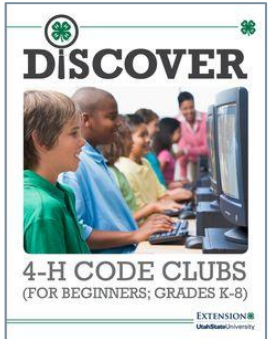
Discovering Computer Science & Programming through Scratch: Level 1 Facilitator Guide

This guide assists facilitators of the abovementioned youth curriculum with basic skills necessary to lead a beginning Scratch programming club. shop4-h.org/products/discovering-computer-science-programming-curriculum-facilitator-guide

National Youth Science Day

4-H National Youth Science Day (NYSD) is the world's largest youth-led science experiment. Every year thousands of youth take part in the National Science Challenge focusing on important STEM topics and issues. The 4-H NYSD event usually takes place the first part of October and is the perfect opportunity to introduce 4-H youth to a CS related project. Watch the 4-H Mall for upcoming dates, themes, and to pre-order kits. shop4-h.org
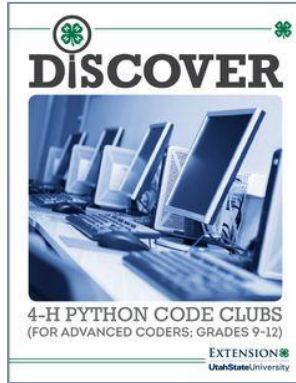
4-H.org/parents/national-youth-science-day

Discovering Computer Science & Programming Through Scratch: Level 1 Youth Guide	Discovering Computer Science & Programming Through Scratch: Level 1 Facilitator Guide	Discover – 4-H Code Clubs (For Beginner, Grades K-8)

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Discover – 4-H Scratch Code Clubs (For Intermediate Coders Ages 9-14)	Discover – 4-H Python Code Clubs (For Advanced Coders Grades 9-12)	Discover – 4-H Robotics Clubs (For Intermediate Coders Ages 9-14)
Discover – 4-H EV3 Robotics Clubs (For Intermediate Coders Ages 9-14)	Discover – 4-H Makey Makey Clubs (For Advanced Coders Grades 9-12)	

CS Community Resources

Click2Science

click2sciencepd.org – Find online resources that provide support and education to develop your own CS program such as Click2Science, which is an interactive, professional development site for trainers, coaches, site directors and frontline staff/volunteers working in out-of-school time STEM programs, serving children and youth.

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Code.org

code.org/educate has a wonderful lineup of curriculum and other programs that correlate with the 4-H age divisions which are listed below:

- Juniors (Grades K-5) – This curriculum is meant to teach youth how computer programmers use geometry and algebra to develop video games.

- Intermediates - Science (Grades 6-8) – This curriculum is meant to help youth explore and develop complex scientific models through agent-based programming.

- Seniors (Grades 9-12) – This is a course designed to broaden youth's participation in computer science.

- Seniors - Advanced (Grades 9-12) – This is an advanced placement course that covers a wide range of CStopics.

Scratch

scratched.media.mit.edu – Developed by MIT as a visual programming language, Scratch makes it easy to create your own interactive stories, animations, games, music and art. It is also a social network that allows youth to share their creations online.

- Scratch – This programming language is for the early beginner yet challenging enough for older youth and even adults.

- ScratchJr – This spin-off of the original Scratch language was recently released and is available for young juniors and cloverbuds.

Google CS First

csfirst.withgoogle.com – Over 4,600 schools have used CS First clubs to introduce CS to students. No CS experience is required to begin teaching or learning. Each CS First club is based on a real-world theme and offers about 10 hours of lessons and activities. The different club themes aim to attract and engage students of varying backgrounds and interests. All materials are targeted at students in 4th - 8th grades (or between the ages of 9 - 14) and are free and easy to use. Club-based themes include:

- Animation

- Art

- Fashion

- Friends

- Game Design

- Music & Sound

- Social Media

- Sports

- Storytelling

Made w/ Code - Google

madewithcode.com – Simply put, code is a tool that lets you write your story with technology. If you can code, you can communicate your ideas with a computer or a program so they can be brought to life in bigger, brighter and more creative ways. Made w/ Code is an online learning site that was developed for girls to get them enthused about coding. If we can inspire teen girls to see that code can help them pursue their passions, whatever they may be, then hopefully they will begin to contribute their voices to the field of technology for the benefit of all.

- Projects
- Party Kit

Pythonroom

pythonroom.com – Pythonroom's free online curriculum and powerful learning management system makes it easy for teachers of any background to get code into the classroom.

AppInventor

appinventor.mit.edu/explore/index-2.html – MIT App Inventor is an innovative beginner's introduction to programming and app creation that transforms the complex language of text-based coding into visual, drag-and-drop building blocks. The simple graphical interface grants even an inexperienced novice the ability to create a basic, fully functional app within an hour or less.

- Get Started
- Tutorials
- Teach

Sew Electric

sewelectric.org – Sew Electric began as a joint project between MIT researchers and the National Center for Women and Information Technology (NCWIT). Together they found new ways to introduce girls to computing. By combining craft, CS and electronics, they found they can consistently get girls (and boys) excited about these topics. And they learn how to sew, write programs and design circuits along the way.
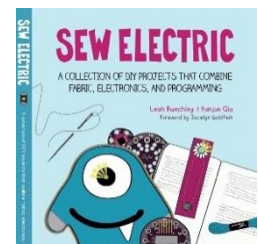
- Sew Electric Project Book

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Blocky Games

blockly-games.appspot.com – Blockly Games is a series of educational games that teach programming. It is designed for children who have not had prior experience with computer programming. By the end of these games, players are ready to use conventional text-based languages.
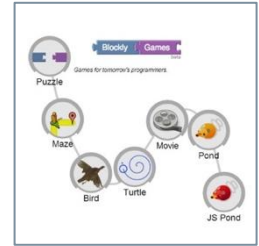
Offline CS Activities

The following is a list of unplugged lessons/activities to use in clubs to teach the fundamentals of CS, whether you have computers or not. Try using these lessons as stand-alone or complementary activities.

- code.org/curriculum/unplugged – Teach the fundamentals of CS, whether you have computers in your classroom or not

- csunplugged.org – Computer Science Unplugged is a free curriculum that is excellent to teach CS activities without a computer.

Resource to Help Youth Understand CS Careers

careerswithcode.com believes that whatever your passion, studying CS opens doors. All you have to add is your 'X' factor – your passion, whether it be art, music, sports, business, social justice, sustainability, health, gaming – anything! You can create your dream career in any field through the power of code. This publication showcases youth in action, building careers in CS, and is a great motivational tool to help inspire youth to look beyond the "coding is only for game developers" stigma.

Online Educational Courses

Coursera.org and EdX.org offer a wide variety of CS-related courses. Each course is like an interactive textbook, featuring pre-recorded videos, quizzes and projects. These 12 week courses are free, however, for a nominal fee you will have access to all of the features and content you need to earn a course certificate. The following courses are recommended for older youth and adult volunteers.

- edX.org – Programming in Scratch edx.org/course/programming-scratch-harveymuddx-cs002x-1

- Coursera – Programming for Everybody (Getting Started with Python) coursera.org/learn/python

- edX.org – Introduction to Computing using Python h.edx.org/course/introduction-computing-using-python-gtx-cs1301x

- edX.org – How to Code: Simple Data www.edx.org/course/how-code-simple-data-ubcx-htc1x

- edX.org – Introduction to Java Programming www.edx.org/course/introduction-java-programming-part-1-hkustx-comp102-1x-3

- edX.org – Programming with c# edx.org/course/programming-c-microsoft-dev204x-3

- MIT Open Courseware ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-092-introduction-to-programming-in-java-january-iap-2010/

- Khan Academy – Learn the basics www.khanacademy.org/computing/computer-programming

- Udemy.com – Learn coding online .udemy.com

Equipment & Supplies

Activities in CS and computational thinking can broadly be classified into two groups:

Unplugged: Doesn't require any kind of electronic device and materials required, are not expensive or difficult to source.

Plugged: Activities that require some kind of equipment ex computer, tablet or robotics kit.

Brief descriptions of equipment that various 4-H programs have useful can be found here: http://bit.ly/2oLDPAv * Not exhaustive and not an endorsement

PLAYBOOK COACH TIP

Finding resources and equipment isn't always easy. 4-H groups have found success in writing small grants for equipment through corporate grants. Other groups have utilized equipment lending programs and are checking with university surplus to get used equipment. Libraries and community centers have allowed 4-H the use their computer labs to teach coding. What resources are in your local community that you might be able to access?

Developing a Plan of Action

Develop a Plan of Action

Now that you have a basic understanding of what CS is, how it could be used in a 4-H program, and examples of curriculum and resources, the next step is to make a game plan. Developing a plan of action to implement or grow a CS program is crucial to its success. To develop the plan consider the following elements and action items. A planning tool can be found here: http://bit.ly/2Nmuehs

Situation Statement – Define the current state of the CS in your county or state. What programs are currently being implemented? What potential resources are currently in place (e.g. funds, equipment, volunteers, etc.)?

Goals – Define the short- and long-term goals for the 4-H CS program. First consider what you want to achieve with your CS program. Keep in mind that location, funding, and resources will all play a factor and must be considered when customizing your individual programs. Set SMART (specific, measurable, attainable, relevant and time-bound) goals that motivate. Then plan the steps you must take to realize your goals.

Inputs – List the resources and types of activities the plan will utilize. This can include volunteer development, equipment, teen leader training, camps, etc.

Outputs – Quantify how many participants, events and trainings.

Outcomes – Consider the short- and long-term impact of the CS program. In the short-term, consider what evaluation tool to employ to measure impact such as 4-H Common Measures. Define what the longer-term impact will be to the program and the community.

Action Items

The following action items should be considered as you develop your plan. Try not to get overwhelmed, and consider starting small and building over time.

Develop an Advisory Council

A valuable tool that assists in building a strong 4-H CS/STEM program is to create a local or regional advisory council. The objective will be to spark interest, increase education, train and prepare talent ready employees, promote entrepreneurship and ultimately help the youth of today to become strong, valuable, contributing members of their communities.

The following are potential prospects for your advisory council:

- Individuals who are CS teachers/deans from local universities or technical institutions who may be interested in increasing enrollment in CS/STEM related classes

- Successful business leaders responsible for recruiting CS talent to their organizations

- School Board members who are proponents of STEM education for youth in the classroom

- County or city leaders who want to broaden their offerings for meaningful youth programs

- Parents of 4-H youth who are eager to help build programs that provide career path opportunities for their children and grandchildren

Connecting with Community Partners

Developing a partnership with those in your community who share a common goal for youth CS development can be a tremendous benefit to your CS program. Community partners are nonprofit organizations, public agencies, government offices, schools and certain private businesses that have a vested interest in developing CS skills in youth in their area or just a love for helping out the community in general. Many successful businesses are looking for ways to give back to the community and are often looking for a worthy cause to which to donate their time or resources. Community partners can help boost your 4-H program in the following ways:

- Funding for equipment and needed supplies
- Providing space for meetings
- Use of in-house equipment
- Coordinating or combining resources for activities
- Providing professional guest speakers or teachers for special trainings
- Co-coaching or co-volunteering to run successful programs
- Proving valuable advice and leadership
- Combining resources to build each other's programs
- Cross promoting each other's businesses and/or programs
- Opportunities for internships

Industry Partnerships

Identify and build partnerships with STEM-rich businesses, industries, community-based organizations/departments and the CS department at local land-grant universities, to facilitate positive CS experiences for youth. Go beyond simply completing a joint project together to building a lasting relationship with stakeholders.

Engaging Volunteers

Building a Diverse Group of Volunteers

A diverse group of volunteers, including teens, corporate and current volunteers, can broaden the range of opinions and ideas to which your organization has access. They bring knowledge of the cultures and circumstances of the population groups they come from, so your organization will have a better understanding of those groups, and be better able to relate to them. They also enrich the organization with their perspectives and the variety of their experiences and backgrounds. A diverse group of volunteers also makes possible heightened cultural sensitivity within the organization, and allows for the kinds of interchanges that make it possible for people with very different backgrounds to understand, respect and cherish one another's differences as well as their similarities.

By encouraging diversity in your organization, you also increase its appeal; different ethnic and racial populations are much more likely to respond if they believe that your group has members who share a similar heritage.

Retaining and Engaging Volunteers

Volunteers are the backbone of the 4-H organization and it's important to take them seriously, recruit them as if you were recruiting paid staff and treat them as an integral part of your organization. If you think carefully about what you want volunteers to do, explain accurately what the job entails and provide some reasons for their wanting to volunteer, you'll have no problem finding good people to help you and to spread the word about your organization – and its volunteer opportunities – to the community. Get them excited about your program and let them know how valuable their offerings are to help make your club a success. Volunteers who feel appreciated and supported will always find the time necessary to be a valuable contributor to your program.

PLAYBOOK COACH TIP

4-H is a very grassroots organization. From county to county and state to state the program resources and delivery varies. Developing a CS Action Plan that reflects the needs and resources of the local program is essential for success. A link with descriptions of five different states CS Programs is here: http://bit.ly/2MTmWT5

A template that you can utilize to begin crafting your own Action Plan can be found here: http://bit.ly/2MJc8Sg

Conclusion

4-H GROWS HERE

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National Vision

CS represents a new opportunity to add a relevant and interesting program to a youth development program. Elements to build your program include: curriculum, program design, program implementation, volunteer recruitment/training, and developing partnerships. It is important to remember that CS can be a stand-alone topic to explore or integrated into other programs and topics. In this section, resources and strategies are highlighted that can serve as a springboard to start building a 4-H CS program.

A Transformational Vision: 10 Million Youth Ready for Life & Career

Just imagine the potential!

- The proven 4-H experience

- Enhanced with an intentional 4-H Career Readiness Framework

- Embraced by a national network of 110 land-grant universities and more than 3,000 4-H educators serving every county and parish in the country

National 4-H Council's bold vision is to impact 10 million youth in the U.S. by 2025 – empowering them with the skills they need to be ready for life today and for their career tomorrow.

Through the support of our partners, we can accelerate program piloting, resource development and program delivery to impact more youth, more quickly. Together, 4-H and its partners will grow a generation who will lead in the workplace and in the community.

Summary

It is our hope that this playbook sparks interest and ideas for incorporating a CSand computational thinking game plan that works for your specific program. With various 4-H delivery modes or content areas for your state or county 4-H programs we recognize that each game plan will look different and work for the local program. The playbook may serve as a blueprint for 4-H educators, volunteers, and teen leaders to integrate CS programming into any aspect of the 4-H experience. We wish you the best as you develop a plan that will work for your program that will meet the needs of the youth we serve.

Please share your successes, wins, and positive impacts with others on this amazing CS pathway journey.

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