Virtual Museum

Minimum experience: Grades 3+, 1st year using Scratch, 1st quarter or later

At a Glance

Overview and Purpose

Coders collaboratively research and create a virtual museum that responds when a user clicks on a sprite. The purpose of this project is to review understandings from the previous projects and prepare coders for the following project in the suggested sequence (Interactive Art).

Objectives and Standards

Process objective(s):	Product objective(s):
Statement: ● I will learn how to collaborate with others to create a coding project. **Question:** ● How can we collaborate with others to create a coding project?	**Statement:** ● I will collaborate with others to create an interactive, virtual museum. **Question:** ● How can we collaborate with others to create an interactive, virtual museum?
Main standard(s):	**Reinforced standard(s):**
1B-AP-10 Create programs that include sequences, events, loops, and conditionals ● Control structures specify the order (sequence) in which instructions are executed within a program and can be combined to support the creation of more complex programs. Events allow portions of a program to run based on a specific action. For example, students could write a program to explain the water cycle and when a specific component is clicked (event), the program would show information about that part of the water cycle. Conditionals allow for the execution of a portion of code in a program when a certain condition is true. For example, students could write a math game that asks multiplication fact questions and then uses a conditional to check whether or not the answer that was entered is correct. Loops allow for the repetition of a sequence of code multiple times. For example, in a program that produces an animation about a famous historical character, students could use a loop to have the character walk across the screen as they introduce themselves. (source)	**1B-AP-14** Observe intellectual property rights and give appropriate attribution when creating or remixing programs. ● Intellectual property rights can vary by country but copyright laws give the creator of a work a set of rights that prevents others from copying the work and using it in ways that they may not like. Students should identify instances of remixing, when ideas are borrowed and iterated upon, and credit the original creator. Students should also consider common licenses that place limitations or restrictions on the use of computational artifacts, such as images and music downloaded from the Internet. At this stage, attribution should be written in the format required by the teacher and should always be included on any programs shared online. (source) **1B-AP-15** Test and debug (identify and fix errors) a program or algorithm to ensure it runs as intended. ● As students develop programs they should continuously test those programs to see that they do what was expected and fix (debug), any errors. Students should also be able to successfully debug simple errors in programs created by others. (source)

1B-AP-16 Take on varying roles, with teacher guidance, when collaborating with peers during the design, implementation, and review stages of program development. ● Collaborative computing is the process of performing a computational task by working in pairs or on teams. Because it involves asking for the contributions and feedback of others, effective collaboration can lead to better outcomes than working independently. Students should take turns in different roles during program development, such as note taker, facilitator, program tester, or "driver" of the computer. (source)	**1B-AP-17** Describe choices made during program development using code comments, presentations, and demonstrations. ● People communicate about their code to help others understand and use their programs. Another purpose of communicating one's design choices is to show an understanding of one's work. These explanations could manifest themselves as in-line code comments for collaborators and assessors, or as part of a summative presentation, such as a code walk-through or coding journal. (source)

Practices and Concepts

Source: K–12 Computer Science Framework. (2016). Retrieved from http://www.k12cs.org.

Main practice(s):	Reinforced practice(s):
Practice 2: Collaborating around computing ● "Collaborative computing is the process of performing a computational task by working in pairs and on teams. Because it involves asking for the contributions and feedback of others, effective collaboration can lead to better outcomes than working independently. Collaboration requires individuals to navigate and incorporate diverse perspectives, conflicting ideas, disparate skills, and distinct personalities. Students should use collaborative tools to effectively work together and to create complex artifacts." (p. 75) ● **P2.1.** Cultivate working relationships with individuals possessing diverse perspectives, skills, and **personalities. (p. 75)** ● **P2.2.** Create team norms, expectations, and equitable workloads to increase efficiency and effectiveness (p. 76) **Practice 5: Creating computational artifacts** ● "The process of developing computational artifacts embraces both creative expression and the exploration of ideas to create prototypes and solve computational problems. Students create artifacts that are personally relevant or beneficial to their community and beyond. Computational artifacts can be created by combining and modifying existing artifacts or by developing new artifacts. Examples of computational artifacts include programs, simulations, visualizations, digital animations, robotic systems, and apps." (p. 80) ● **P5.2.** Create a computational artifact for practical intent, personal expression, or to address a societal issue. (p. 80) ● **P5.3.** Modify an existing artifact to improve or customize it. (p. 80)	**Practice 6: Testing and refining computational artifacts** ● "Testing and refinement is the deliberate and iterative process of improving a computational artifact. This process includes debugging (identifying and fixing errors) and comparing actual outcomes to intended outcomes. Students also respond to the changing needs and expectations of end users and improve the performance, reliability, usability, and accessibility of artifacts." (p. 81) ● **P6.1.** Systematically test computational artifacts by considering all scenarios and using test cases." (p. 81) ● **P6.2.** Identify and fix errors using a systematic process. (p. 81) **Practice 7: Communicating about computing** ● "Communication involves personal expression and exchanging ideas with others. In computer science, students communicate with diverse audiences about the use and effects of computation and the appropriateness of computational choices. Students write clear comments, document their work, and communicate their ideas through multiple forms of media. Clear communication includes using precise language and carefully considering possible audiences." (p. 82) ● **P7.2.** Describe, justify, and document computational processes and solutions using appropriate terminology consistent with the intended audience and purpose. (p. 82) ● **P7.3.** Articulate ideas responsibly by observing intellectual property rights and giving appropriate attribution. (p. 83)
Main concept(s):	**Reinforced concept(s):**

Algorithms	**Control**
• "Algorithms are designed to be carried out by both humans and computers. In early grades, students learn about age-appropriate algorithms from the real world. As they progress, students learn about the development, combination, and decomposition of algorithms, as well as the evaluation of competing algorithms." (p. 91) • **Grade 5 -** "Different algorithms can achieve the same result. Some algorithms are more appropriate for a specific context than others." (p. 103)	• "Control structures specify the order in which instructions are executed within an algorithm or program. In early grades, students learn about sequential execution and simple control structures. As they progress, students expand their understanding to combinations of structures that support complex execution." (p. 91) • **Grade 5 -** "Control structures, including loops, event handlers, and conditionals, are used to specify the flow of execution. Conditionals selectively execute or skip instructions under different conditions." (p. 103)

Scratch Blocks	
Primary blocks	Events, Looks
Supporting blocks	Control, Motion, Sound

Vocabulary	
Algorithm	• A step-by-step process to complete a task. (source) • A formula or set of steps for solving a particular problem. To be an algorithm, a set of rules must be unambiguous and have a clear stopping point. (source)
Backdrop	• One out of possibly many frames, or backgrounds, of the Stage. (source)
Debugging	• The process of finding and correcting errors (bugs) in programs. (source) • To find and remove errors (bugs) from a software program. Bugs occur in programs when a line of code or an instruction conflicts with other elements of the code. (source)
Event (trigger)	• An action or occurrence detected by a program. Events can be user actions, such as clicking a mouse button or pressing a key, or system occurrences, such as running out of memory. Most modern applications, particularly those that run in Macintosh and Windows environments, are said to be event-driven,because they are designed to respond to events. (source) • The computational concept of one thing causing another thing to happen. (source) • Any identifiable occurrence that has significance for system hardware or software. User-generated events include keystrokes and mouse clicks; system-generated events include program loading and errors. (source)
Scripts	• One or more Scratch blocks connected together to form a sequence. Scripts begin with an event block that responds to input (e.g., mouse click, broadcast). When triggered, additional blocks connected to the event block are executed one at a time. (source)
Sprite	• A media object that performs actions on the stage in a Scratch project. (source)
CSTA Glossary	• More vocabulary words and definitions created by the Computer Science Teachers Association

Connections	
Integration	**Potential subjects:** Any **Example(s):** This project can be modified to include themes from any subject area, topic, or theme.

	Click here for a studio with similar projects.
Vocations	This project relates to any vocation where people share information with the public about a topic. For example, historians, biologists, social scientists, researchers, etc. Click here to visit a website dedicated to exploring potential careers through coding.

Resources

- Example project
- Video walkthroughs
- Quick reference guides
- Project files

Project Sequence

Preparation (20+ minutes)

Suggested preparation	Resources for learning more

Customizing this project for your class (10+ minutes): Remix the project example to include objects of interest to your class or to other subject areas coders are studying.
 	
(10+ minutes) Read through each part of this lesson plan and decide which sections the coders you work with might be interested in and capable of engaging with in the amount of time you have with them. If using projects with sound, individual headphones are very helpful.
 	
Download the offline version of Scratch: Although hopefully infrequent, your class might not be able to access Scratch due to Scratch's servers going down or your school losing internet access. Events like these could completely derail your lesson plans for the day; however, there is an offline version of Scratch that coders could use when Scratch is inaccessible. Click here to download the offline version of Scratch on to each computer a coder uses and click here to learn more by watching a short video.
	• BootUp Scratch Tips
	  ○ Videos and tips on Scratch from our YouTube channel
	• BootUp Facilitation Tips
	  ○ Videos and tips on facilitating coding classes from our YouTube channel
	• Scratch Starter Cards
	  ○ Printable cards with some sample starter code designed for beginners
	• ScratchEd
	  ○ A Scratch community designed specifically for educators interested in sharing resources and discussing Scratch in education
	• Scratch Help
	  ○ This includes examples of basic projects and resources to get started
	• Scratch Videos
	  ○ Introductory videos and tips designed by the makers of Scratch
	• Scratch Wiki
	  ○ This wiki includes a variety of explanations and tutorials

Getting Started (10+ minutes)

Suggested sequence	Resources, suggestions, and connections
1. Review and demonstration (2+ minutes): Begin by asking coders to talk with a neighbor for 30 seconds about something they learned last time; assess for general understanding of the practices and concepts from the previous project.	**Practices reinforced:** • Communicating about computing **Video:** Project Preview (1:51) **Video:** Lesson pacing (1:48)

Explain that today we are going to create a virtual museum. Display and demonstrate the sample project (or your own remixed version).	This can include a full class demonstration or guided exploration in small groups or individually. For small group and individual explorations, you can use the videos and quick reference guides embedded within this lesson, and focus on facilitating 1-on-1 throughout the process. **Example review discussion questions:** ● What's something new you learned last time you coded? ○ Is there a new block or word you learned? ● What's something you want to know more about? ● What's something you could add or change to your previous project? ● What's something that was easy/difficult about your previous project?
2. Discuss and divide into teams (8+ minutes): Have coders talk with each other about how they might create a project like the one demonstrated. If coders are unsure, and the discussion questions aren't helping, you can model thought processes: "I noticed the sprite moved around, so I think they used a motion block. What motion block(s) might be in the code? What else did you notice?" Open it up to a full group discussion. Another approach might be to wonder out loud by thinking aloud different algorithms and testing them out, next asking coders "what do you wonder about or want to try?" Divide into groups and create teams focusing on different themes coders are interested in. Discuss how the team will work together throughout the research portion of the project and when we start coding; however, point out that each person will create their own museum. Give the time for the team to think through who will research what aspect of their theme or topic.	**Standards reinforced:** ● **1B-AP-16** Take on varying roles, with teacher guidance, when collaborating with peers during the design, implementation, and review stages of program development **Practices reinforced:** ● Communicating about computing **Note:** Discussions might include full class or small groups, or individual responses to discussion prompts. These discussions which ask coders to predict how a project might work, or think through how to create a project, are important aspects of learning to code. Not only does this process help coders think logically and creatively, but it does so without giving away the answer. **Potential museum themes:** dinosaurs, video games, technology, sea creatures, birds, sports, science, art, music, history, aviation, military, healthcare, architecture, furniture, food and nutrition, climate, germs, geography, human body, cartoons, or broad topics such as things that are stinky, slimy, fast, boring, memes, etc. Another suggestion for themes would be to discuss with their teacher what themes tie into grade level specific content. **Example discussion questions:** ● What would we need to know to make something like this in Scratch? ● What kind of blocks might we use? ● What else could you add or change in a project like this? ● What code from our previous projects might we use in a project like this? ● What kind of sprites might we see in a museum? ○ What kind of code might they have?

Project Work (90+ minutes; 3+ classes)

Suggested sequence	Resources, suggestions, and connections
3. Research a theme or topic (30+ minutes, or one class): ***5 minute review and research demonstration*** Discuss how to find out information online about the museum theme(s) chosen for this project. Demonstrate how to search for facts about the different theme(s). ***25+ minute researching time and 1-on-1 facilitating*** Give coders time to work together to research and document information about their museum topic. Encourage peer-to-peer assistance and facilitate each group 1-on-1 as needed.	**Standards reinforced:** ● **1B-AP-16** Take on varying roles, with teacher guidance, when collaborating with peers during the design, implementation, and review stages of program development **Practices reinforced:** ● Collaborating around computing **Note:** This step can be skipped if they research their theme in another class; however, it might help to remind the class (and their teacher) to bring in their research notes.
4. Log in (1-15+ minutes): If not yet comfortable with logging in, review how to log into Scratch and create a new project. If coders continue to have difficulty with logging in, you can create cards with a coder's login information and store it in your desk. This will allow coders to access their account without displaying their login information to others.	**Why the variable length of time?** It depends on comfort with login usernames/passwords and how often coders have signed into Scratch before. Although this process may take longer than desired at the beginning, coders will eventually be able to login within seconds rather than minutes. **What if some coders log in much faster than others?** Set a timer for how long everyone has to log in to their account (e.g., 5 minutes). If anyone logs in faster than the time limit, they can open up previous projects and add to them. Your role during this time is to help out those who are having difficulty logging in. Once the timer goes off, everyone stops their process and prepares for the following chunk.
5. Add sprites from outside of Scratch (15+ minutes): ***5 minute review and research demonstration*** Explain we can add images into our projects as sprites or backdrops. Demonstrate how to save an image from an online source, then use the folder to add a sprite from the device. Demonstrate how to give credit on the project page by indicating where sprites were obtained from and copy and paste the original link. ***10+ minutes to add images and 1-on-1 facilitating*** Give coders time to work together to determine what images they will add into each of the projects. Encourage peer-to-peer assistance and facilitate 1-on-1 as needed.	**Standards reinforced:** ● **1B-AP-14** Observe intellectual property rights and give appropriate attribution when creating or remixing programs **Practices reinforced:** ● Collaborating about computing ● Communicating about computing **Video:** Add sprites from outside of Scratch (2:13) **Quick reference guide:** Click here **Note:** This can lead to a discussion on intellectual property rights and when you can and cannot use images created by other people. Click here for a blog post with resources on the topic, and click here for videos on the topic. **A note on using the "Coder Resources" with your class:** Young coders may need a demonstration (and semi-frequent friendly reminders) for how to navigate a browser with multiple tabs. The reason why is because kids will have at least three tabs open while working on a project: 1) a tab for Scratch, 2) a tab for the Coder Resources walkthrough, and 3) a tab for the video/visual walkthrough for each step in the Coder Resources document. Demonstrate how to navigate between these three tabs and point out that coders will close the video/visual walkthrough once they complete that particular step of a project and open a new tab for the next step or extension. **Although this may seem obvious for many adults, we**

	recommend doing this demonstration the first time kids use the Coder Resources and as friendly reminders when needed.
6. Remove backgrounds from your images (15+ minutes): ***5 minute review and research demonstration*** Explain we can edit the way our sprites look to remove background in images we find online. Demonstrate how to use the eraser and the magic wand tool to remove backdrops from images. ***10+ minute researching time and 1-on-1 facilitating*** Give coders time to clean up their sprites. Encourage peer-to-peer assistance and facilitate 1-on-1 as needed. You may need to set a timer for this section as coders can spend a lot of time cleaning up images.	**Practices reinforced:** ● Collaborating about computing **Video:** Remove backgrounds from your images (2:49) **Quick reference guide:** Click here
7. Code your museum (30+ minutes, or one class): ***2 minute demonstration*** Quickly review how to use the say and think blocks with a when sprite clicked block to make it so our sprites say facts about the sprite and then do something else with code. ***28+ minute coding time and 1-on-1 facilitating*** Have coders continue to collaborate with their group, but work on their own museum projects. Facilitate 1-on-1 as needed.	**Standards reinforced:** ● **1B-AP-10** Create programs that include sequences, events, loops, and conditionals **Practices reinforced:** ● Collaborating about computing ● Communicating about computing ● Testing and refining computational artifacts ● Creating computational artifacts **Concepts reinforced:** ● Algorithms ● Control **Video:** Code your museum (1:52) **Quick reference guide:** Click here **Facilitation Suggestion:** Some coders may not thrive in inquiry based approaches to learning, so we can encourage them to use the Tutorials to get more ideas for their projects; however, we may need to remind coders the suggestions provided by Scratch are not specific to our projects, so it may create some unwanted results unless the code is modified to match our own intentions.
8. Add in comments (*the amount of time depends on typing speed and amount of code*): ***1 minute demonstration*** When the project is nearing completion, bring up some code for the project and ask coders to explain to a neighbor how the code is going to work. Review how we can use comments in our program to add in explanations for code, so others can understand how our programs work. Quickly review how to add in comments. ***Commenting time*** Ask coders to add in comments explaining the code throughout their project. Encourage coders to write clear and concise comments, and ask for clarification or elaboration when needed.	**Standards reinforced:** ● **1B-AP-17** Describe choices made during program development using code comments, presentations, and demonstrations **Practices reinforced:** ● Communicating about computing **Concepts reinforced:** ● Algorithms **Video:** Add in comments (1:45) **Quick reference guide:** Click here **Facilitation suggestion:** One way to check for clarity of comments is to have a coder read out loud their comment and ask another coder to recreate their comment using code

	blocks. This may be a fun challenge for those who type fast while others are completing their comments.

Assessment

Standards reinforced:

- **1B-AP-17** Describe choices made during program development using code comments, presentations, and demonstrations

Practices reinforced:

- Communicating about computing

Although opportunities for assessment in three different forms are embedded throughout each lesson, this page provides resources for assessing both processes and products. If you would like some example questions for assessing this project, see below:

Summative Assessment *of* Learning	**Formative** Assessment *for* Learning	**Ipsative** Assessment *as* Learning
The debugging exercises, commenting on code, and projects themselves can all be forms of summative assessment if a criteria is developed for each project or there are "correct" ways of solving, describing, or creating. **For example, ask the following after a project:** ● Can coders debug the debugging exercises? ● Did coders create a project similar to the project preview? ○ **Note:** The project preview and sample projects are not representative of what all grade levels should seek to emulate. They are meant to generate ideas, but expectations should be scaled to match the experience levels of the coders you are working with. ● Did coders use a variety of block types in their algorithms and can they explain how they work together for specific purposes? ● Did coders include descriptive comments for each event in all of their sprites? ● Did coders create a museum that interacts with a user clicking on various sprites? ● Did coders cite in their project page where they got their	The 1-on-1 facilitating during each project is a form of formative assessment because the primary role of the facilitator is to ask questions to guide understanding; storyboarding can be another form of formative assessment. **For example, ask the following while coders are working on a project:** ● What are three different ways you could change that sprite's algorithm? ● What happens if we change the order of these blocks? ● What could you add or change to this code and what do you think would happen? ● How might you use code like this in everyday life? ● See the suggested questions throughout the lesson and the assessment examples for more questions.	The reflection and sharing section at the end of each lesson can be a form of ipsative assessment when coders are encouraged to reflect on both current and prior understandings of concepts and practices. **For example, ask the following after a project if they've done some coding before:** ● How is this project similar or different from previous projects? ○ What about considering how you collaborated with others? ● What new code or tools were you able to add to this project that you haven't used before? ● How can you use what you learned today in future projects? ● What questions do you have about coding that you could explore next time? ● See the reflection questions at the end for more suggestions.

images or information from? ● Did coders collaborate with their peers throughout the research and coding processes? ● Did coders include at least ## sprites with unique algorithms explaining or demonstrating something about that sprite? ○ Choose a number appropriate for the coders you work with and the amount of time available.		

Extended Learning

Project Extensions

Suggested extensions	Resources, suggestions, and connections
Add even more (30+ minutes, or at least one class): If time permits and coders are interested in this project, encourage coders to explore what else they can create in Scratch by trying out new blocks and reviewing previous projects to get ideas for this project. When changes are made, encourage them to alter their comments to reflect the changes (either in the moment or at the end of class). While facilitating this process, monitor to make sure coders don't stick with one feature for too long. In particular, coders like to edit their sprites/backgrounds by painting on them or taking photos, or listen to the built-in sounds in Scratch. It may help to set a timer for creation processes outside of using blocks so coders focus their efforts on coding.	**Standards reinforced:** ● **1B-AP-10** Create programs that include sequences, events, loops, and conditionals **Practices reinforced:** ● Testing and refining computational artifacts ● Creating computational artifacts **Concepts reinforced:** ● Algorithms ● Control **Facilitation Suggestion:** Some coders may not thrive in inquiry based approaches to learning, so we can encourage them to use the Tutorials to get more ideas for their projects; however, we may need to remind coders the suggestions provided by Scratch are not specific to our projects, so it may create some unwanted results unless the code is modified to match our own intentions. **Suggested questions:** ● What else can you do with Scratch? ● What do you think the other blocks do? a. Can you make your project do ____? ● What other sprites can you add to your project? ● What have you learned in other projects that you could use in this project? ● Can you create multiple "rooms" in this museum and a way for a user to navigate between the rooms?
Similar projects: Have coders explore the code of other peers in their class, or on a project studio dedicated to this project. Encourage coders to ask questions about each other's code. When changes are made, encourage coders to alter their comments to	**Standards reinforced:** ● **1B-AP-10** Create programs that include sequences, events, loops, and conditionals ● **1B-AP-12** Modify, remix, or incorporate portions of an existing program into one's own work, to develop something new or add more advanced features

reflect the changes (either in the moment or at the end of class). Watch this video (3:20) if you are unsure how to use a project studio.	**Practices reinforced:** ● Testing and refining computational artifacts **Concepts reinforced:** ● Algorithms **Note:** Coders may need a gentle reminder we are looking at other projects to get ideas for our own project, *not to simply play around*. For example, "look for five minutes," "look at no more than five other projects," "find three projects that each do one thing you would like to add to your project," or "find X number of projects that are similar to the project we are creating." **Generic questions:** ● What are some ways you can expand this project beyond what it can already do? ● How is this project similar (or different) to something you worked on today? ● What blocks did they use that you didn't use? a. What do you think those blocks do? ● What's something you like about their project that you could add to your project?
micro:bit extensions: **Note:** the micro:bit requires installation of Scratch Link and a HEX file before it will work with a computer. Watch this video (2:22) and use this guide to learn how to get started with a micro:bit before encouraging coders to use the micro:bit blocks. Much like the generic Scratch Tips folder linked in each Coder Resources document, the micro:bit Tips folder contains video and visual walkthroughs for project extensions applicable to a wide range of projects. Although not required, the micro:bit Tips folder uses numbers to indicate a suggested order for learning about using a micro:bit in Scratch; however, coders who are comfortable with experimentation can skip around to topics relevant to their project.	**Standards reinforced:** ● **1B-AP-09** Create programs that use variables to store and modify data ● **1B-AP-10** Create programs that include sequences, events, loops, and conditionals ● **1B-AP-11** Decompose (break down) problems into smaller, manageable subproblems to facilitate the program development process ● **1B-AP-15** Test and debug (identify and fix errors) a program or algorithm to ensure it runs as intended **Practices reinforced:** ● Recognizing and defining computational problems ● Creating computational artifacts ● Developing and using abstractions ● Fostering an inclusive computing culture ● Testing and refining computational artifacts **Concepts reinforced:** ● Algorithms ● Control ● Modularity ● Program Development ● Variables **Folder with all micro:bit quick reference guides:** Click here **Additional Resources:** ● Printable micro:bit cards ○ Cards made by micro:bit ○ Cards made by Scratch ● Micro:bit's Scratch account with example projects **Generic questions:** ● How can you use a micro:bit to add news forms of user interaction?

	• What do the different micro:bit event blocks do and how could you use them in a project? • How could you use the LED display for your project? • What do the tilt blocks do and how could you use them in your project? • How could you use the buttons to add user/player controls? • How might you use a micro:bit to make your project more accessible?

Differentiation

Less experienced coders	More experienced coders
Demonstrate the example remix project or your own version, and walk through how to experiment changing various parameters or blocks to see what they do. Give some time for them to change the blocks around. When it appears a coder might need some guidance or has completed an idea, encourage them to add more to the project or begin following the steps for creating the project on their own (or with BootUp resources). Continue to facilitate one-on-one using questioning techniques to encourage tinkering and trying new combinations of code. If you are working with other coders and want to get less experienced coders started with remixing, have those who are interested in remixing a project watch this video (2:42) to learn how to remix a project.	Demonstrate the project without showing the code used to create the project. Challenge coders to figure out how to recreate a similar project without looking at the code of the original project. If coders get stuck reverse engineering, use guiding questions to encourage them to uncover various pieces of the project. Alternatively, if you are unable to work with someone one-on-one at a time of need, they can access the quick reference guides and video walkthroughs above to learn how each part of this project works. If you are working with other coders and want to get more experienced coders started with reverse engineering, have those who are interested watch this video (2:30) to learn how to reverse engineer a project.

Debugging Exercises (1-5+ minutes each)

Debugging exercises	Resources and suggestions
Why do we only see one line of text instead of all four lines of say blocks when the potato is clicked? • We need to use the say blocks with the numbers or add a wait after each say block Why don't we hear a sound when Nano is clicked? • We do not have any sounds in the Sounds tab. Add the sound with the same name and then the code will work. Why does the potato talk so fast when clicked? • The say blocks should not have a decimal before the numbers Even more debugging exercises	**Standards reinforced:** • **1B-AP-15** Test and debug (identify and fix errors) a program or algorithm to ensure it runs as intended **Practices reinforced:** • Testing and refining computational artifacts **Concepts reinforced:** • Algorithms • Control **Suggested guiding questions:** • What should have happened but didn't? • Which sprite(s) do you think the problem is located in? • What code is working and what code has the bug? • Can you walk me through the algorithm (steps) and point out where it's not working? • Are there any blocks missing or out of place? • How would you code this if you were coding this algorithm from Scratch? • Another approach would be to read the question out loud and give hints as to what types of blocks (e.g., motion, looks, event, etc.) might be missing.

	Reflective questions when solved: ● What was wrong with this code and how did you fix it? ● Is there another way to fix this bug using different code or tools? ● *If this is not the first time they've coded:* How was this exercise similar or different from other times you've debugged code in your own projects or in other exercises?

Unplugged Lessons and Resources

Although each project lesson includes suggestions for the amount of class time to spend on a project, BootUp encourages coding facilitators to supplement our project lessons with resources created by others. In particular, reinforcing a variety of standards, practices, and concepts through the use of unplugged lessons. Unplugged lessons are coding lessons that teach core computational concepts without computers or tablets. You could start a lesson with a short, unplugged lesson relevant to a project, or use unplugged lessons when coders appear to be struggling with a concept or practice.

Suggested unplugged lessons:

1. The hokey pokey
    a. Using code to program the hokey pokey.
2. fuzzFamily Frenzy (Beginner)
    a. A beginner unplugged lesson on using algorithms to move a "robot" (coder) around a path

List of unplugged lessons and resources

Incorporating unplugged lessons in the middle of a multi-day project situates understandings within an actual project; however, unplugged lessons can occur before or after projects with the same concepts. **An example for incorporating unplugged lessons:**

Lesson 1.	Getting started sequence and beginning project work
Lesson 2.	Continuing project work
Lesson 3.	Debugging exercises and unplugged lesson that reinforces concepts from a project
Lesson 4.	Project extensions and sharing

Reflection and Sharing

Reflection suggestions	Sharing suggestions
Coders can either discuss some of the following prompts with a neighbor, in a small group, as a class, or respond in a physical or digital journal**.** If reflecting in smaller groups or individually, walk around and ask questions to encourage deeper responses and assess for understanding. Here is a sample of a digital journal designed for Scratch (source) and here is an example of a printable journal useful for younger coders. **Sample reflection questions or journal prompts:** ● How did you use computational thinking when creating your project? ● What's something we learned while working on this project today? ○ What are you proud of in your project? ○ How did you work through a bug or difficult challenge today?	**Standards reinforced:** ● **1B-AP-17** Describe choices made during program development using code comments, presentations, and demonstrations **Practices reinforced:** ● Communicating about computing ● Fostering an inclusive culture **Concepts reinforced:** ● Algorithms ● Control ● Modularity ● Program development **Peer sharing and learning video:** Click here (1:33) At the end of class, coders can share with each other something they learned today. Encourage coders to ask questions about each other's code or share their journals with

- What other projects could we do using the same concepts/blocks we used today?
- What's something you had to debug today, and what strategy did you use to debug the error?
- What mistakes did you make and how did you learn from those mistakes?
- How did you help other coders with their projects?
    - What did you learn from other coders today?
- What questions do you have about coding?
    - What was challenging today?
- Why are comments helpful in our projects?
- How is this project similar to other projects you've worked on?
    - How is it different?
- How did someone else's project differ from yours in how it showed information?
- What did you learn by working with other coders?
- More sample prompts

each other. When sharing code, encourage coders to discuss something they like about their code as well as a suggestion for something else they might add.

Publicly sharing Scratch projects: If coders would like to publicly share their Scratch projects, they can follow these steps:

1. **Video:** Share your project (2:22)
    a. Quick reference guide
2. **Video (Advanced):** Create a thumbnail (4:17)
    a. Quick reference guide