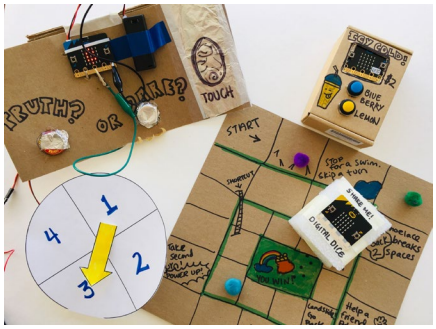
WEEK 8 DAY 1: INTRODUCING THE CYBER ARCADE



INTRODUCTION

This week makers begin planning the culminating event, the Cyber Arcade! Makers work together with a project-based approach, designing interactive games using the Micro:bit and maker materials. For the final three weeks, makers synthesize ideas and concepts explored in the past weeks through a repeating cycle of designing, making, and discussion.

ESSENTIAL QUESTIONS

- What is a game or interactive project we want to share with our community?
- What technology and tools do we want to explore further?
- How do artists, engineers, and makers solve problems when they're working?

LEARNING OUTCOMES

1. Design, plan, and build interactive projects for a community event.
2. Engage in project-based learning through problem-solving and troubleshooting by creating a game using a Micro:bit microcontroller and code.

VOCABULARY

Project planning: Process of clarifying goals and listing the steps and materials required to complete a project

Brainstorm: Thinking about and coming up with many ideas or solutions, either on your own or in a group

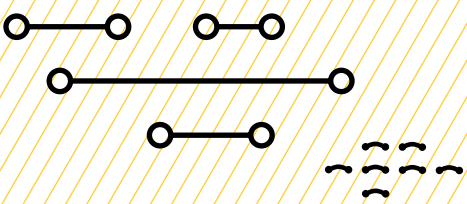
Game mechanics: Basic actions, processes, visuals, and control mechanisms that are used to make a game

Game designer: Person responsible for designing game storylines, plots, objectives, scenarios, degree of difficulty, and character development

Game engineer: Specialized software engineer who designs and programs video games

Pseudocode: Detailed, informal description of what a computer program must do

Troubleshooting: Using resources to solve issues as they arise



MATERIALS LIST

EACH PAIR OF MAKERS NEEDS:

- Micro:bit microcontroller
- External battery pack
- AAA batteries (2)
- Laptop with internet connection
- USB to micro-USB cord
- USB flash drive
- Notebook
- Markers
- Colored pencils
- Scissors
- Cardboard scissors

ALL MAKERS NEED ACCESS TO:

- Alligator clips
- Alligator-to-pin wires
- Buttons (momentary and locking)
- Servos
- Tape (masking, painters, duct)
- Aluminum foil
- Assorted cardboard
- Assorted paper
- Pipe cleaners, pom-poms, popsicle sticks
- Misc bottle caps/recycling (optional)
- Hot glue gun and glue sticks (see Facilitation Tips)

Items can be portioned out per table or set up in an area where students can access them freely.

TEACHER PREP WORK

1. Ensure the internet connection is working and connect your laptop to a projector or screen.
2. Preload videos and slideshows to save time.
3. Set up an equitable system for student access of materials (either as a materials area or distributed evenly per table).
4. Set up a hot glue station and/or box cutter station, covered with newspaper or butcher paper.
5. Print the **Brainstorm and Project Planning worksheet** for each group, along with a few extras.
6. Print the **Troubleshooting Tips** the end of the lesson and post in the classroom.

FACILITATION TIPS

Inspiring creativity: If makers have trouble generating ideas, try brainstorming with a pair that is struggling or with the whole group, prompting them with questions like "What games or activities would you see at a real arcade or carnival?" If they continue to struggle, share a list of **examples**.

Safety: Using hands-on tools is an empowering part of this curriculum. However, practicing safety while working is crucial when using hot glue and sharp tools. You know your makers best, so make adjustments and adaptations as necessary. If makers misuse any tools, have them take a break from the tool and return at your discretion.

Note: If you don't feel comfortable letting makers use hot glue on their own, you can set up an area where you help them hot glue connections they can't achieve in other ways.

Box cutter (Teacher Use Only): If you're comfortable using a box cutter, you can help makers with cardboard cuts they can't do on their own with scissors. Ask them to draw a visible line with a marker where they want the cut. Encourage them to use the regular and cardboard scissors for most of their other cuts.

Guidelines for using the box cutter:

- Extend the blade of your box cutter out to the minimum needed to cut your material.
- Be sure that the pathway of the knife is not in line with any part of your body, including your other hand and your legs.
- Don't push down hard—instead, take multiple passes to make a cut.
- Retract the knife fully when not in use.
- Pass the knife only when retracted.
- Change dull or dirty blades.

ADDITIONAL RESOURCES

Behind the MakeCode Hardware: Servo Motors with Micro:bit

Driving a Servo with the Micro:bit

Connecting a Servo Motor to the Micro:bit

INTRODUCING THE CYBER ARCADE

STEP 1 (5 MINUTES)

Introduce the Cyber Arcade.

"Caine Monroy: Inventors Challenge 2019" on YouTube, uploaded by Imagination Fdn, 5/24/2019

Show this video of Caine Monroy to introduce the idea of a cardboard challenge and arcade games.

EXPLAIN

Caine Monroy became famous for his creativity at the age of nine, but he has never stopped learning and imagining. Here, he explains why Arcade Games are important to him and his community.

We've done so much learning and exploring with the Micro:bit together in the last 7 weeks! First, give your partner, classmates, and yourself a big high five!

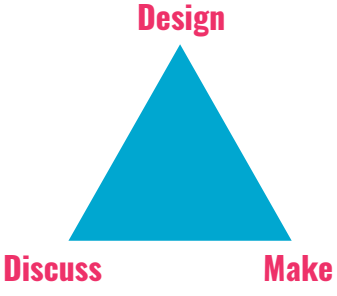
We'll use the rest of the sessions to apply what we've learned to create Micro:bit interactive arcade games to host a Cyber Arcade event! We'll have 3 weeks to design and make, and on the last day we'll have an open arcade and play each other's games!

With the corresponding slides, briefly review the skills and concepts that have been covered in the last 7 weeks.

- Week 1: Designed and connected **LED circuits**
- Week 2: Programmed a Micro:bit with **inputs** and **outputs**
- Week 3: Designed games with **conditionals** and **number ranges** and **game mechanics**
- Week 4: Connected and programmed **homemade switches** and **arcade buttons**
- Week 5: Connected **speakers** and **programmed sounds**
- Week 6: Explored **cardboard engineering** to build **prototypes**
- Week 7: Connected and programmed **servo motors**

STEP 2 (10 MINUTES)

Brainstorm.



Give each group a copy of the **Brainstorm for the Cyber Arcade worksheet**.

First, makers work together to **brainstorm** at least 4 different ideas. Then, through discussion, they choose one idea to work on. If makers have trouble generating ideas, try brainstorming with a pair that is struggling or with the whole group, prompting them with questions like "What games or activities would you see at a real arcade or carnival?" If they continue to struggle, share a list of **examples**.

EXPLAIN

For the next 3 weeks, you and your partner will design, make, and code an interactive game or activity for visitors of the Cyber Arcade! Think about what kind of game or experience you want to design. Who are you designing for? What kinds of things would you see at a real arcade, amusement park, or carnival?

Here's the criteria for what your project will include:

1. **Construction:** Use cardboard engineering techniques.
2. **Inputs:** Include at least one programmed input.
3. **Programming**: Use either conditional and/or number ranges for the game mechanics.
4. **Electronic components**: Include at least one programmed button or switch, speaker, or servo. You can include as many as you like.

There are 3 phases we cycle through as we work: **design**, **make**, and **discuss**.

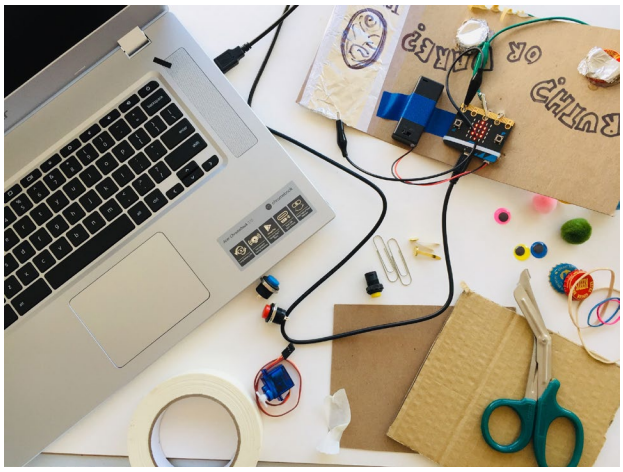
1. **Design:** Brainstorm ideas. What kind of game or experience do you want the user to have? What are its inputs and outputs? What materials will you need? How will you program it?
2. **Make:** You and your partner are doing the work of programming, making and building. You're troubleshooting and solving problems as you work. You can assign tasks for this so it's clear who is doing what and when.
3. **Discuss:** It's important that you and your partner communicate, especially when troubleshooting and solving problems. You may need to stop to reflect and make changes to your designs as you work.

To begin, you and your partner will brainstorm a list of ideas for a Cyber Arcade project. Once you decide on an idea, you'll work together to create a **project plan** to help keep you on track for the next few weeks.

In Step 1 on your worksheet, come up with at least 4 different project ideas and describe how the user would interact with each one.

STEP 3 40 MINUTES

Create a project plan and make.



Once groups have chosen an idea to work on, it's time to create a project plan by filling out the **Project Plan** section of the worksheet. Makers will share their idea with the rest of the group to ensure that groups aren't doing the same project. All the groups are working collaboratively to create a variety of games for the Cyber Arcade!

EXPLAIN

Once you and your partner choose an idea you want to work on, it's time to write up a project plan. In almost any professional job or sport, teams use project plans to make sure that all the different tasks get done to complete a project. Be open to changing your original plan as you make. We'll have limited time to work on these, so you might need to simplify for the most important parts of your project. Also, figure out who will do what in order to get your project ready in time to present.

Makers work together to fill out the brainstorming and project plan sheets. Once makers have filled out these sheets and shared them with you for review, they can begin gathering materials.

STEP 4 5 MINUTES

Clean up.

Makers will:

- Put any materials they want to keep to use in their partner bin.
- Put away technology and make sure laptops are charging.
- Return tools and materials that can be used again to the right place.
- Clear tables of garbage and recycling.

PROJECT IDEAS

Jukebox	Program 2 buttons to play music and animate a display.
Food Stand	Use a homemade switch as an input to place an order, and use an animated display or sound to show when food is ready.
Strength Test	Use a homemade switch to choose a random number to show how "strong" the user is.
Digital Dice	Program the Micro:bit as a dice, and create game mechanics for the numbers.
Racing Game	Use 2 Micro:bits programmed to show random numbers that display how many spaces the cars should move.
Truth or Dare	Program 2 switches, where the user chooses T or D and the numbers mean different truth or dares.
Fortune Teller	The Servo Spinner chooses a random number to turn to, which points to a fortune.
Spaceship Ride	Build a mini cardboard spaceship with buttons and an interactive LED screen.
Cotton Candy	Program a switch to move the servo that moves cotton candy to the user.
Ticket Counter	Program the Micro:bit to show the number of tickets to give to a user.

DESIGN AND DISCUSS — BRAINSTORM FOR THE CYBER ARCADE

Step 1: Brainstorm.

Make a list of ideas. This is not the time to judge ideas or think too much about it. Write down as many ideas as you can come up with (for example, Truth or Dare, Strength Meter, Fortune Teller).

What is the project idea?	How would the user interact with it?
1.	1.
2.	2.
3.	3.
4.	4.

Step 2: Discuss and decide.

From the list above, discuss with your partner and come to an agreement on which idea you want to move forward with. Use the space below to draw and take notes as you talk.

DESIGN AND DISCUSS — PROJECT PLAN FOR THE CYBER ARCADE

Title_____

1. In a few sentences, describe your Cyber Arcade project.

2. How will you build it? What engineering techniques do you plan to use?

CYBER ARCADE — TECHNICAL PLAN

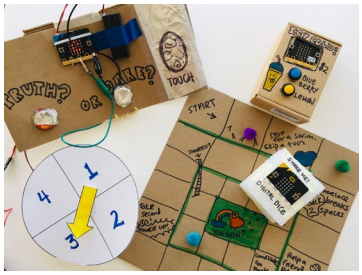
3. How will you program your game? (Write the pseudocode of the number ranges or conditionals.)

4. List what inputs and outputs you'll program.
Inputs: How will the user interact with the project? (buttons, shake, etc.)
Outputs: What happens when they interact with it? (shows animation, plays sound, etc.)

INPUTS *(Example: Press a momentary switch.)*	**OUTPUTS** *(Example: Will give you a fortune.)*

5. Which parts will you use? (switch, button, speaker, servo)

WEEK 8 DAY 2: CYBER ARCADE CONTINUED



INTRODUCTION

In this session, makers continue working on their interactive games with a project-based approach. For these final weeks, makers are experimenting with and synthesizing concepts explored in past lessons.

ESSENTIAL QUESTIONS

- What is a game or interactive project we want to share with our community?
- What ideas and tools do we want to explore further?
- How do artists, engineers, and makers solve problems when they're working?

LEARNING OUTCOMES

1. Engage in a creative and collaborative process (design, make, and discuss).
2. Engage in project-based learning through problem-solving and troubleshooting by creating a game using a Micro:bit microcontroller and code.

VOCABULARY

Project planning: Process of clarifying goals and listing the steps and materials required to complete a project

Game mechanics: Basic actions, processes, visuals, and control mechanisms that are used to make a game

Game designer: Person responsible for designing game storylines, plots, objectives, scenarios, degree of difficulty, and character development

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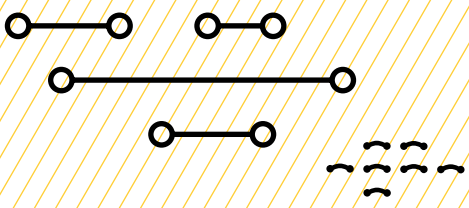

MATERIALS LIST

EACH PAIR OF MAKERS NEEDS:

- Micro:bit microcontroller
- External battery pack
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- Laptop with internet connection
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- Markers
- Colored pencils
- Scissors
- Cardboard scissors

ALL MAKERS NEED ACCESS TO:

- Alligator clips
- Alligator-to-pin wires
- Buttons (momentary and locking)
- Servos
- Tape (masking, painters, duct)
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- Hot glue gun and glue sticks (see Facilitation Tips)

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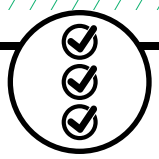

TEACHER PREP WORK

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3. Set up an equitable system for student access of materials (either as a materials area or distributed evenly per table).
4. Set up a hot glue station and/or box cutter station, covered with newspaper or butcher paper.
5. Print the **Project Planning** worksheet for each group, along with a few extras.
6. Print the **Troubleshooting Tips** and Safety Agreements at the end of the lesson and post in the classroom.

FACILITATION TIPS

Safety: See Day 1

Supporting a maker mindset: Project-based making and coding is all about learning by making mistakes and encountering challenges. When makers get frustrated that something doesn't work out as planned, remind them that feeling frustrated is normal and that professional game designers, engineers, and artists experience similar challenges every day.

Encourage makers to talk with their partner and classmates and to rethink and redesign as necessary. Often just vocalizing an issue with someone can help make space for the next steps and possible solutions. Remind makers of the cycle of "design, make, discuss." Explain that it's a cycle—often, when creating something new, makers need to redesign after learning from things that don't work out the first time.

Managing technology, electronics, and making: Part of the excitement of this project is the combination of using computers, code, electronics, and hands-on making materials together. Remind makers to clean up their work areas as they go. It may be helpful to circulate the room to remind makers to establish work zones and help clear cardboard and recycling around groups as they work.

Collaboration: Let smaller issues work themselves out. Record specific positive examples that you can share with makers in the moment or at the end of the project. These examples provide models for all learners.

Frustration: When frustration levels aren't high, let learners figure it out or keep facilitation low-touch by asking a question and walking away. When frustration levels are high, intervene more directly to help makers find some success.

Circulate among the makers and monitor for both collaboration and frustration.

ADDITIONAL RESOURCES

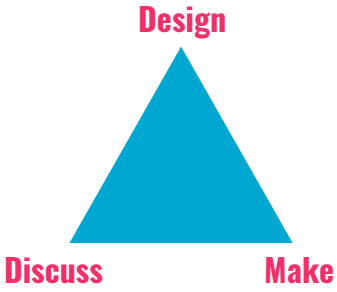
Micro:bit Game Design with Conditionals

Wonderful Idea Co: Computational Carnival

DESIGNING A GAME WITH A SERVO

STEP 1 5 MINUTES

Revisit project plans and safety.



EXPLAIN

Today we'll continue working within the design, make, and discuss cycle. In the last session, you designed and discussed a plan with your partner using the project planning tool. Maybe you even started making.

Now, take a few minutes to review your project plan with your partner. Be open to redesigning as needed during the process. Decide on your goals for today and what the most important parts are to get your project complete in time.

As a reminder, when we're working with many tools, materials, and people we want to make ensure we're working safely when sharing space.

Review the Safety Agreements with makers before getting started.

SAFETY AGREEMENTS

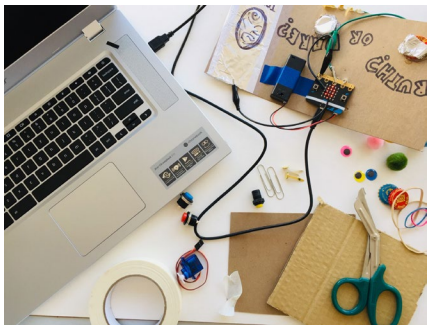
1. Take care when walking with scissors or sharp things (hold with point facing down).
2. One maker at a time per tool prevents accidents.
3. Be mindful of space from others when using tools.

GLUE GUN SAFETY

- Only 1–2 makers at the hot glue station at a time.
- Don't touch the tip of the glue gun.
- Don't point the glue gun at another person.
- Work at the protected glue gun station.
- Keep the glue gun close to your work.
- If the glue gun jams, ask an adult for support.

STEP 2 45 MINUTES

Makers work as game designers and game engineers.



This block of time is for makers to work on their projects. Ensure that every group has enough space to safely work on coding and making.

- Circulate through the room and facilitate safe working habits by celebrating safe behaviors and calling attention to any unsafe behaviors (see Facilitation Tips).
- Help groups troubleshoot only after they've tried on their own for some time and after they've asked classmates.
- Give suggestions to groups on how to improve their engineering, coding, etc., on an organic and 1:1 basis.
- Only give whole group support if you notice something that is coming up for many groups.
- Help students with making cuts on their cardboard if you're comfortable using the box cutter (see Facilitation Tips).
- If makers get frustrated or express conflict, have them stop making to discuss and redesign as needed.

Collaboration: Let smaller issues work themselves out. Record specific positive examples that you can share with makers in the moment or at the end of the project. These examples provide models for all learners.

Frustration: When frustration levels aren't high, let learners figure it out or keep facilitation low touch by asking a question and walking away. When frustration levels are high, intervene more directly to help makers find some success.

STEP 3 5 MINUTES

Reflect and discuss.

Before makers clean up their work area, take 5 minutes for written reflection. Makers get their notebooks and answer the following:

1. Was anything challenging for you today? How did you work through it?
2. Are there any changes (redesigns) you need to make on your project plan? If so, what are they?
3. What will you start with when we return for the next session?

Note: Remind makers to save their files onto their USB flash drive.

STEP 4 5 MINUTES

Clean up.

Makers will:

- Put any materials they want to keep to use in their partner bin.
- Put away technology and make sure laptops are charging.
- Return tools and materials that can be used again to the right place.
- Clear tables of garbage and recycling.

SAFETY AGREEMENT

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GLUE GUN SAFETY

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2. Don't touch the tip of the glue gun.
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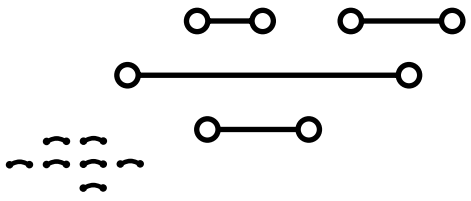
5. Keep the glue gun close to your work.
6. If the glue gun jams, ask an adult for support.

TROUBLESHOOTING TIPS

The cardboard is difficult to cut.	• Using the inside of the scissors instead of the tip can make cutting easier. • Cutting pieces away from the edge of the cardboard is easier than cutting out a shape from the middle of the cardboard. • If you're really having a hard time, ask a classmate or adult to help you with cuts.
The hot glue isn't holding stuff in place.	• Hot glue dries quickly, so try to apply the glue a little at a time instead of large amounts. • After gluing, hold the pieces in place for at least 20 seconds before releasing. • Support two pieces with an L-bracket or a bridge, using glue or tape.
The cardboard won't hold the shape.	• Try experimenting with a different joining technique. • Try different thicknesses of cardboard or layers of cardboard.
The board isn't showing what we coded.	**File version check** • Check to see that you uploaded the most recent copy of the code. • Resave the latest version and drag and drop it onto the Micro:bit.
Our code isn't doing what we expected.	**Check for bugs** • Read through the code. • Read it out to a friend. • Check to see if there are extra blocks that aren't supposed to be there.

The LED on the Micro:bit isn't flashing when we click Upload.	**Bad cable or port** • If the Micro:bit isn't showing up in the computer menu, try a different cable. • Try a different USB port on the laptop.
Our code isn't uploading correctly to the board. The board feels hotter than usual.	**Burnt board** • Try pressing the reset button on the board. • Try uploading to a new Micro:bit board.
Our board isn't turning on when connected to the battery pack.	**Battery** • Check the batteries to see if they're charged. • Check to see if the batteries are flipped.
We have alligator clips connected to the board, but the code isn't running.	**Alligator clips** • Make sure alligator clips are secure on the correct pins and are touching the metallic parts. • Try switching alligator clips.



TROUBLESHOOTING TIPS

Print and use the empty rows to fill in with other problems and solutions that can be shared.