Design for Safety

Design for safety curriculum is aiming at teaching students about engineering and designing thinking processes through electronic creativities. Now we are facing the problem of lack of skills in many technical fields. This curriculum is meant to provide an inspiring education experience to growing children through micro:bit projects, and to teach how creativity could be applied to the problems students may encounter in their real lives. Furthermore, students will learn that technical limitations should not be the constraint to their creativity. Above all, through this class, students will learn the basic application methods of coding, be encouraged to express their creativity through designs, and be empowered to apply what they learned in real-life scenarios from three stages of learning.

Overall Learning Goals

- **THINK LIKE AN ENGINEER** - Experience how engineers use technology to solve daily life problems
- **EMPATHY DESIGN** - Be aware of safety problems in daily life and practice design thinking for the solution
- **LEARN FROM COMMUNITY** - Collaborate and learn from peers with different levels of knowledge
- **CRAFTING SKILLS** - Gain Hands-on experience and learn crafting techniques

Stage 3

Lesson 1 - What is design for safety

Lesson Overview:

Learning design for safety at schools is not only about keeping themselves safe from schools - it's also about helping students feel safe and opportunities to think about which danger they should be prevented from (from other situations) and how they could be prepared for it.

Time: 45-60 mins

Learning Goals:

- To help students understand the problem of safety
- The learning goal of design for safety is the process of identifying safety and reducing risks through their creative tools.
- Help students to understand how the design could help minimum risk of accidents.
- Safety design practices, which will result in improved safety and fewer accidents.

Learning Objectives:

- To help students understand the problem of safety
- To explore themselves what danger's around them and how they could be

Topic Area: Design for Safety

Background Information:

Design for Safety provides design engineers and engineering managers with a range of tools and techniques for incorporating safety into the design process for complex systems.

Supplies/Budget:

Material	Type	Budget
Paper & Pen	Consumables	$10

Steps:

Introduction (20 mins)	Discuss about "Design for Safety" - Reason why we choose this topic - Why knowing 'Design for Safety' is important

Student Discussion (15 mins)	Discuss the example of “Design for Safety” around them Brainstorming about “Safety” Could it be possible to craft your idea? (connecting idea and craft)
Student Activities (10 mins)	Sketch the idea and talk & present with your groups (Group in 4-6)

Assessment: Students can identify what dangers are around them and try to find which creativity could help to solve the problems.

Lesson 2 - Create a Name Tag with Micro:bit

Lesson Overview:

- Explain and discuss with students 'Why we use micro:bit' for our solution and execution.
- Benefits of learning coding : How technology helps to solve problems?

Time: 60-75 mins

Learning Goals:

- Get to know about micro:bit
- What is micro:bit and how does it work?

Learning Objectives:

- Students will be able to approach basic knowledge of coding
- Students will get an idea or get interested in coding

Topic Area: Micro:bit basics

Background Information:

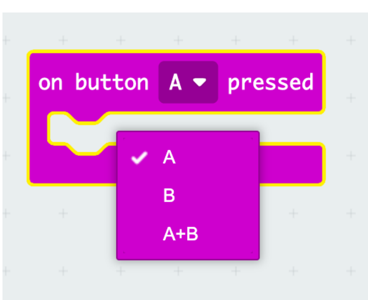
Coding - [*Children must be taught **how** to think not **what** to think by Margaret Mead*]

Crafting [What] + Coding [How]

Conditional Statements

In coding, when you want to ask your app a question, you program it to check a condition. A condition is something that a computer can decide is either true or false. True is like the computer is answering yes and false is like answering no. You can tell your app to do different things depending on if the condition is true or false.

Specifically, in this project, the conditional statement will be to decide which button is pushed on micro:bit.



Supplies/Budget:

Material	Type	Budget
Tangible Coding Pieces	Reuseable	Birch Wood Board: $4 (2 pieces) Acrylic Board: $4 (The whole kits need 1 ¼ inch acrylic which costs $16) Laser Cutter fee: Unknown (Free at NYU labs)
Micro : bit	Reuseable	micro:bit: $15
Materials for decorating	Consumable	Not limited | Depends on (Ex : Fabric, Lace, Ribbons, Paper, Beads, Clay, Pape…)

Steps:

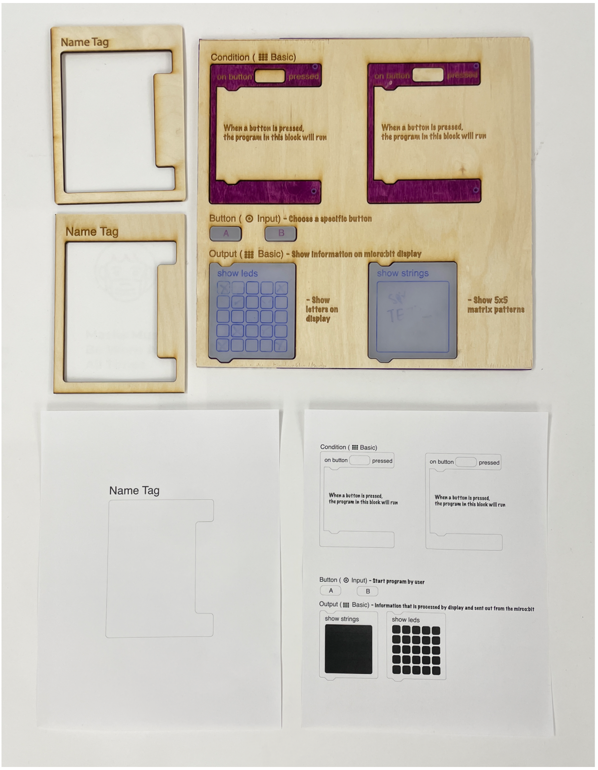
Introduction (40 mins)	Discuss about why learning codes are helpful and why we choose micro : bit? Introduce about micro : bit (What is it?) How it works (Process)
[Coding] Student Activities (20 mins)	Follow (instructor's) basic codes with tangible coding pieces Make a group of 2-3 and explain each other about codes Make different messages and create codes with tangible pieces (ex. Mission: Spell out your name one letter at a time, Create your logo..)
[Crafting] Student Activities (15 mins)	Design group name tag by using the materials of decorating. (no limitation : it could be wearable, at objects etc)

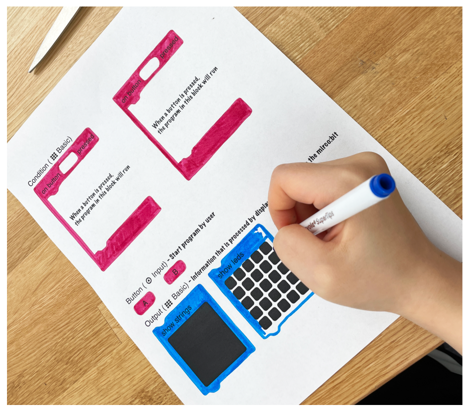
Notice to Instructor & Student : When students and instructor play with micro:bit, *please be aware that don't use safety pins as the metal could damage micro:bit*

Tangible Coding Pieces

We understand that laser cutters might not be available to the program and materials are expensive. In this case, we create a paper version as another option.

Instructors can provide students with scissors to cut out the shape and color pens to color the blocks based on the makecode standard to promote understanding of blocks and digital interfaces.





Assessment:

- Students can identify the basic knowledge of coding
- Students can think about spaces like how technology helps and solve their problems.

Lesson 3 - Night Safety I: What is design for night safety

Lesson Overview:

Students develop their understanding around road safety at night and explore potential solutions before planning, creating and testing a Night sensor using the micro:bit.

Time: 60-75 mins

Learning Goals:

Students will recognize and identify night safety issues and potential solutions with micro:bit.

Learning Objectives:

- To identify potentially dangerous situations at night
- To explore ways technology can help people stay safe at night.
- To describe what a conditional statement is with the tangible coding pieces

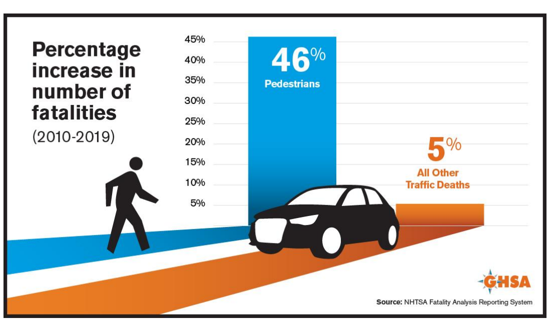
Topic Area: Night Safety

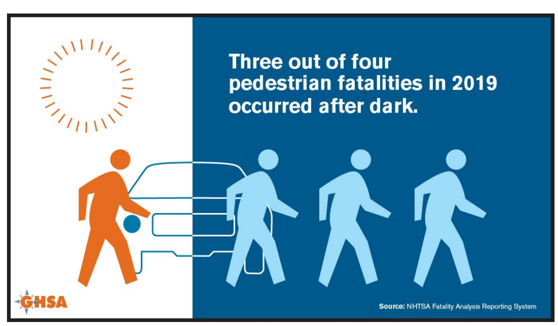
Background Information:

Night Safety:

An analysis of data reported by State Highway Safety Offices (SHSOs) projects that 6,721 pedestrians were killed on U.S. roads in 2020, up 4.8% from 6,412 fatalities in 2019. In addition to the nationwide trend, the number of pedestrian fatalities has also been surging here in New York City, with the five boroughs recently experiencing the deadliest six-month span for pedestrians in recent history.

According to the same report, the need for safer road crossings and efforts to make pedestrians more visible through better lighting and other strategies is one of the trends that affect the rise in pedestrian deaths. As New York State's Governor's Traffic Safety Committee suggests, see and be seen are the most important practices.





Vision Zero is a program created by New York City Mayor Bill de Blasio in 2014. Its purpose is to eliminate all traffic deaths and serious injuries on New York City streets by 2024. The plan includes criminal charges against traffic violators, speed limit reduction from 30 to 25 miles per hour (48 to 40 km/h), slow zones, increased enforcement, **increased use of speed cameras, quicker repairing broken traffic signals**, and strict enforcement on taxi drivers. It also includes **adding "leading pedestrian interval" signals**, which allow pedestrians to start crossing before parallel vehicular traffic has a green light, to 800 signalized intersections per year.

For the previous five years, it received credit for the reduction in traffic fatalities. However, now pedestrian accidents are on the rise, once again.

Coding:

In this project, the coding concept that will be introduced is If-Conditional Statement and Loop.

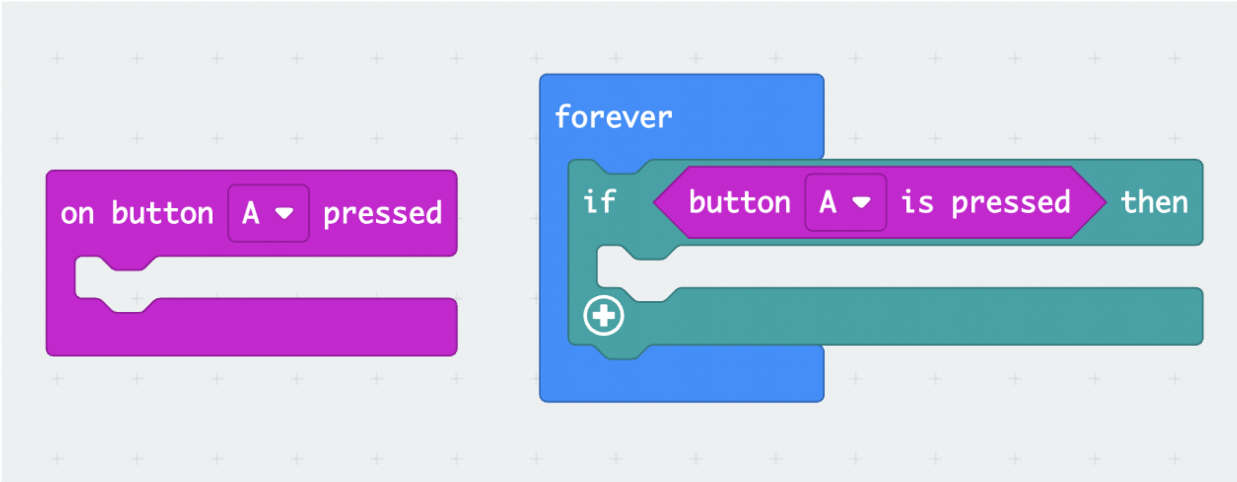
If-Conditional Statement

> We learned about conditions and some conditional statements from last class. We know that conditional statements are the way computers can make decisions. Besides the button condition we learned before, in the real coding world, standard conditional statements always have an if part, which tells the app what to do when the condition is true.

Loop

> Imagine you were asked to write your name down 100 times in a row. This might take you a long time, and you might make a few mistakes along the way. This is a perfect task for a computer, which would be able to do it really fast and without any mistakes. You can take advantage of this by using loops. A loop is a block of code that will repeat over and over again.
>
> In makecode, the **forever loop** means the program in that block will start repeating once the micro:bit is on and end till it's off.

If we want to use if-conditional statements in makecode, we need to put the block in a forever loop to let the computer check the condition all the time. The following is how we could change the conditional statement we learned from the last project to a if-conditional statement.



Supplies/Budget:

Material	Type	Budget
Tangible Coding Pieces (Night Sensor)	Reuseable	Birch Wood Board: $4 (2 pieces) Acrylic Board: $4 (The whole kits need 1 ¼ inch acrylic which costs $16) Laser Cutter fee: Unknown (Free at NYU labs)
Night Sensor Prototype	Reuseable	micro:bit: $15
Paper and Pens	Consumable	$10

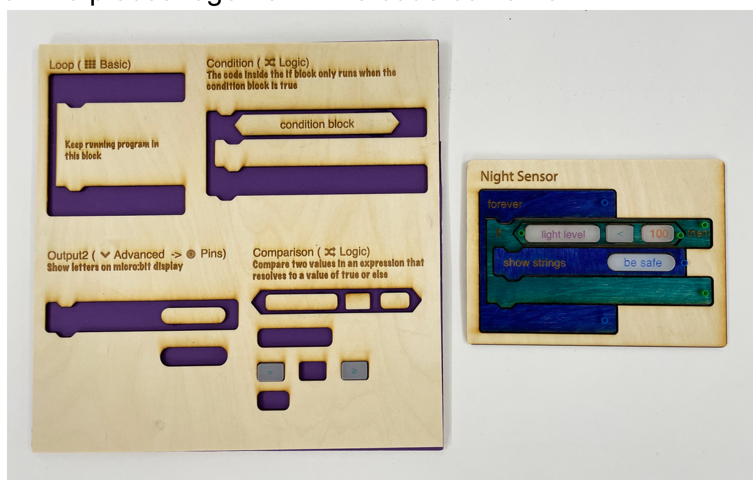
Steps:

Introduction (15 mins)	Introduce some facts about the pedestrian safety situation in New York. In groups or pairs, invite students to consider and share the main problems around road safety for students.
How can technology help? (15 mins)	Talk about the current campaigns/solutions that use technology. Give groups paper and pens and ask them to brainstorm potential ideas – encourage them to think creatively. Present the night sensor prototype made by the instructor.
Introduce Coding Concepts for	Introduce what is an if - conditional statement and let

<table>
<tr>
<td>the Night sensor (35 mins)</td>
<td>students figure out how they can write the conditional statement from the name tag project in an if-condition statement.

Introduce what is a forever loop.

Explain the meaning of each tangible piece used for the night sensor.

In groups, let students play with the tangible piece and put all the pieces together in the code container.


Ask students to explain the finished code to each other to ensure they understand the block's meaning.</td>
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Flexibility:

Discussion on night safety

You could ask them to focus on a particularly vulnerable group when thinking of night safety problems if you wish (e.g. children with visual or hearing impairments).

When talking about how technology helps, Vision Zero could be one example. But more options or more detailed examples like a reflective safety vest at night can be chosen based on the instructor's knowledge and experience.

Tangible Coding Pieces

We understand that laser cutters might not be available to the program and materials are expensive. In this case, we create a paper version as another option.

Instructors can provide students with scissors to cut out the shape and color pens to color the blocks based on the makecode standard to promote understanding of blocks and digital interfaces.

Assessment:

Formative:

Explaining activity: check if students can explain their codes thoroughly.

Summative:

The tangible pieces should be put in the code container in correct order.

Lesson 4 - Night Safety II: Create a night sensor with Micro:bit

Lesson Overview:

Students will apply the coding knowledge they learned from the previous lesson and design the night sensor using micro:bit.

Time: 60-75 mins

Learning Goals:

Students will create their night sensor with micro:bit for their chosen scenarios.

Learning Objectives:

- To incorporate LED display into safety design
- To explore how same input and output can be applied to different scenarios

Topic Area: Night Safety

Background Information:

Coding:

In this project, the coding concept that will be introduced is If-Conditional Statement and Loop.

If-Conditional Statement

> We learned about conditions and some conditional statements from last class. We know that conditional statements are the way computers can make decisions. Besides the button condition we learned before, in the real coding world, standard conditional statements always have an if part, which tells the app what to do when the condition is true.

Loop

> Imagine you were asked to write your name down 100 times in a row. This might take you a long time, and you might make a few mistakes along the way. This is a perfect task for a computer, which would be able to do it really fast and without any mistakes. You can take advantage of this by using loops. A loop is a block of code that will repeat over and over again.
>
> In makecode, the **forever loop** means the program in that block will start repeating once the micro:bit is on and end till it’s off.

Supplies/Budget:

Material	Type	Budget
Tangible Coding Pieces (Night Sensor)	Reuseable	Birch Wood Board: $4 (2 pieces) Acrylic Board: $4 (The whole kits need 1 ¼ inch acrylic which costs $16) Laser Cutter fee: Unknown (Free at NYU labs)
Micro:bit	Reuseable	micro:bit: $15 per each
Materials for decorating	Consumable	Not limited | Depends on (Ex : Fabric, Lace, Ribbons, Paper, Beads, Clay, Pape…)

Steps:

Review (15 mins)	In groups, put the tangible pieces in the container together. Write about personal understanding of each block on the back of the pieces.
Brainstorming (15 mins)	In groups, discuss and brainstorm ideas about the scenarios they want to put a night sensor on. Use the tangible coding pieces as a prototype tool to decide what conditions and parameters they want for their design.
Making and documentation (40 mins)	Upload the code to micro:bit and make the night sensor based on their design. Document the process and share reflections.

Flexibility:

Tangible Coding Pieces

We understand that laser cutters might not be available to the program and materials are expensive. In this case, we create a paper version as another option.

Instructors can provide students with scissors to cut out the shape and color pens to color the blocks based on the makecode standard to promote understanding of blocks and digital interfaces.

Assessment:

Formative:

Review Activity - Check if their written understanding is correct.

Summative:

Students' micro:bit sensors should work as expected and can explain the application scenario.

Lesson 5 - Classroom Safety I: What is the design for classroom safety

Lesson Overview:

Students discuss the unsafe factors in the classroom and work collaboratively to find out some potential solutions before planning, creating and testing a tilt alarm using the micro:bit.

Time: 60-75 mins

Learning Goals:

Students will recognize and identify classroom safety issues and potential solutions with micro:bit.

Learning Objectives:

- To be aware of and describe potential safety problems in classroom settings.
- To be able to explain what an accelerometer is and how it works.
- To be able to interpret what pin control is and correctly apply the codes.

Topic Area: Classroom safety

Background Information:

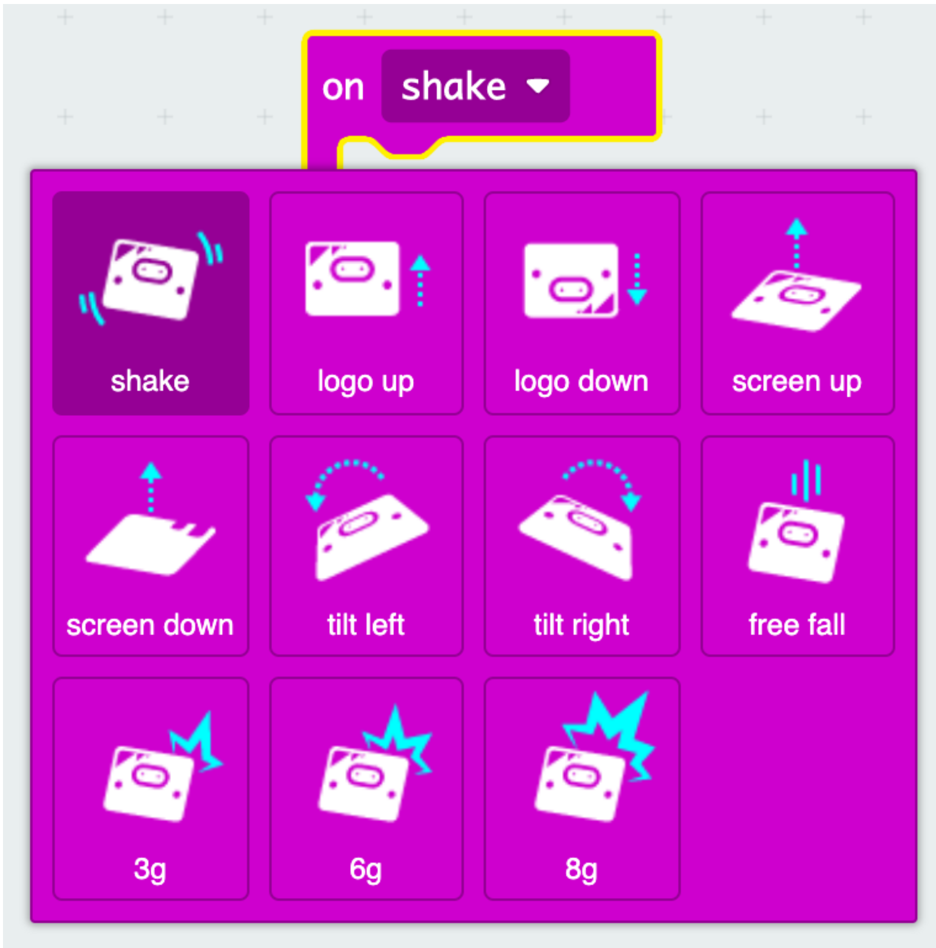
In the UK there has been a rise in the number of child accidents at school, particularly in primary and middle schools. According to the Health and Safety Executive, between 2005 and 2010 there were 35,041 reported accidents involving children. According to the Royal Society for the Prevention of Accidents (ROSPA), every year 30,000 children trap and crush their fingers in doors. The most common finger trapping incidents happen in the hinge side of doors, where gaps provide an easy resting place for small fingers. In this case, ensuring that fixtures and fitting are maintained is essential to minimizing dangers in the classroom.

Besides the fixtures and fittings, what are some other possible problems lying underneath? Fire safety in the classroom is another question. The United States Fire Association reports that there are more than 4,000 school fires every year, and almost half of them occurred in classrooms.

Fall is another significant cause of student injuries. And while many falls happen on the playground, classrooms present their own challenges. Lots of classrooms today have computer labs, for example, where cables can be an issue. Classrooms often have a trash can, which can also create tripping hazards when some students roughhouse in the classroom.

Useful devices and creative technology designs can help reduce the possibility of accidents. Making a tilt alarm can help students be aware of a falling object and handle emergencies immediately. The accelerometer on micro:bit can detect the tilt of any angle (with adjustable precision). An accelerometer works using an electromechanical sensor that is designed to measure either static or dynamic acceleration. Static acceleration is the constant force acting on a body, like gravity or friction. These forces are predictable and uniform to a large extent. For example, the acceleration due to gravity is constant at 9.8m/s, and the gravitational force is almost the same at every point on earth.

Micro:bit has an on-board accelerometer sensor which can detect different gestures.



Design and make a tilt alarm with micro:bit and place it somewhere in the classroom to help ensure the safety of the classroom. Hint: can be attached to trash can in the classroom, preventing students from tripping by scattered trash if the trashcan is brought down; can be attached to chemical containers in labs, too. Try to be creative about where and how it could be used.

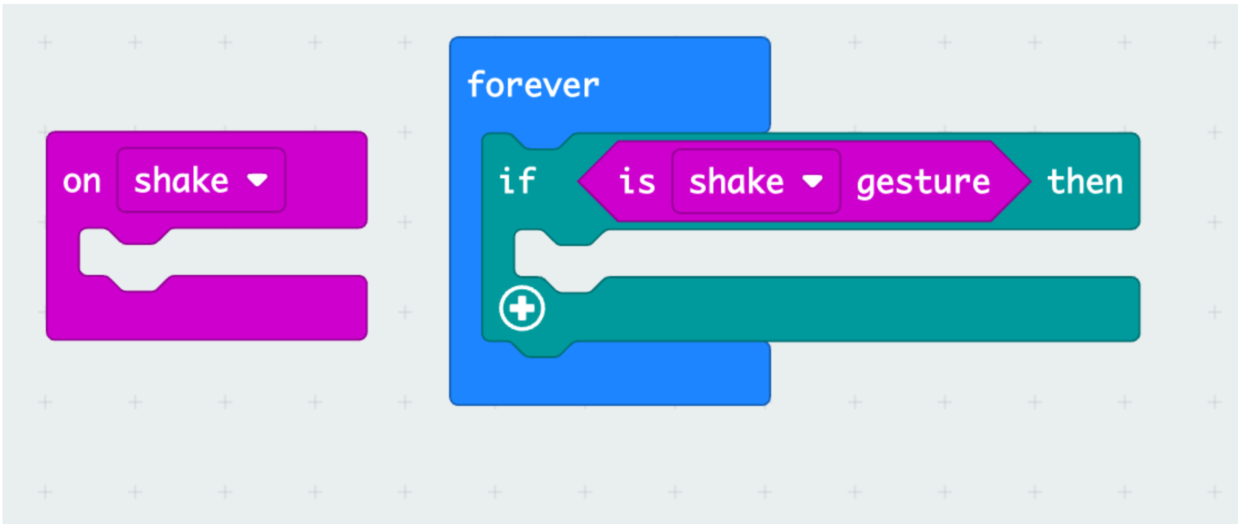
Coding:

In this project, coding concepts will be conditional statements and pin control.

Conditional Statement

The conditional statement for this project will be similar to the conditional statement learned from the name tag project. The difference is that the condition for the name tag project is which button is pressed; in this project, the condition will be whether the accelerometer is shaken or fallen based on the choices.

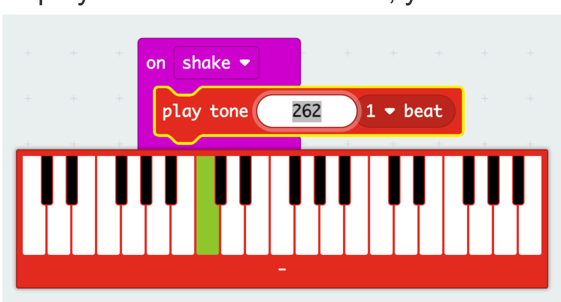
You can ask students to try to rewrite the accelerometer condition block into an if-condition statement as a practice and review if time is allowed.

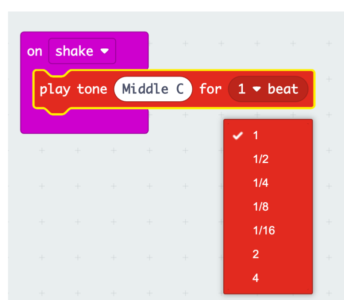


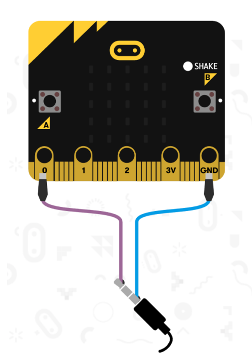
Pin Control

Notice: The new version micro:bits (V2) have on-board speakers which don't require connecting external speakers with pins.

To play a sound on a micro:bit, you need to decide the tone and its frequency.







The pins used in this project are GND pin and 0 Pin as indicated in the image to control the external speaker.

GND pin: attaches to ground in order to complete a circuit.

0 pin: 0: General purpose digital input and output with analogue to digital convertor (ADC).

In this case, the sound signal, which is the tone and frequency decided from the code, and power will be sent out from pin 0 to the speaker and attached to the ground pin to complete the circuit. (**Notice:** We assume students will learn basic circuits concepts from other group's course design and these will not be discussed in our class)

Supplies/Budget:

Material	Type	Budget
Tangible Coding Pieces (Tilt Alarm)	Reuseable	Birch Wood Board: $4 (2 pieces) Acrylic Board: $4 (The whole kits need 1 ¼ inch acrylic which costs $16) Laser Cutter fee: Unknown (Free at NYU labs)
Tilt Alarm Prototype	Reuseable	micro:bit: $15
Paper and Pens	Consumable	$10

Steps:

Introduction (15 mins)	Introduce some facts about the classroom accidents. In groups or pairs, invite students to consider and share the main problems around classroom safety for students.
How does an accelerometer work? (15 mins)	Talk about what an accelerometer is and how it works. Give groups paper and pens and ask them to brainstorm potential ideas about where the alarm could be attached to– encourage them to think creatively. Present the tilt alarm prototype made by the instructor. The prototype making guide can be found here.
Introduce Coding Concepts for the Tilt Alarm (35 mins)	Introduce how to use pins to connect the speaker and let students figure out how they can write the conditional statement with the tilt alarm tangible coding board. Explain the meaning of each tangible piece used for the tilt alarm. In groups, let students play with the tangible piece and put all the pieces together in the code container.

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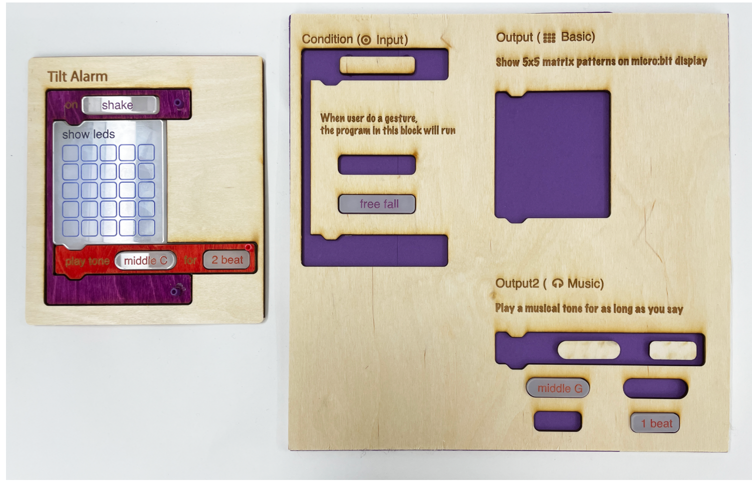
<td>

Ask students to explain the finished code to each other to ensure they understand the meanings of the order.</td>
</tr>
</table>

Flexibility:

Discussion on school safety

The topic can be extended to a broader scope. You could ask them about what are some unsafe factors they find in school and invite them to come up with a solution. The solution does not have to be related to the use of micro:bits and the intention for this discussion is to raise their awareness of in-school safety.

Tangible Coding Pieces

We understand that laser cutters might not be available to the program and materials are expensive. In this case, we create a paper version as another option.

Instructors can provide students with scissors to cut out the shape and color pens to color the blocks based on the makecode standard to promote understanding of blocks and digital interfaces.

Assessment:

Formative: students successfully come up with the right order of codes.

Summative: students can be able to explain why they place the codes this way.

Lesson 6 - Classroom Safety II: Create a tilt alarm with Micro:bit

Lesson Overview:

Students will apply the coding knowledge they learned from the previous lesson and design the tilt alarm using micro:bit.

Time: 60-75 mins

Learning Goals:

Students will apply the coding knowledge they learned from the previous lesson and design the tilt alarm using micro:bit.

Learning Objectives:

- To connect the speaker into their group designs.
- To differentiate the functions of different pins (GND, power, etc.)

Topic Area: Classroom safety

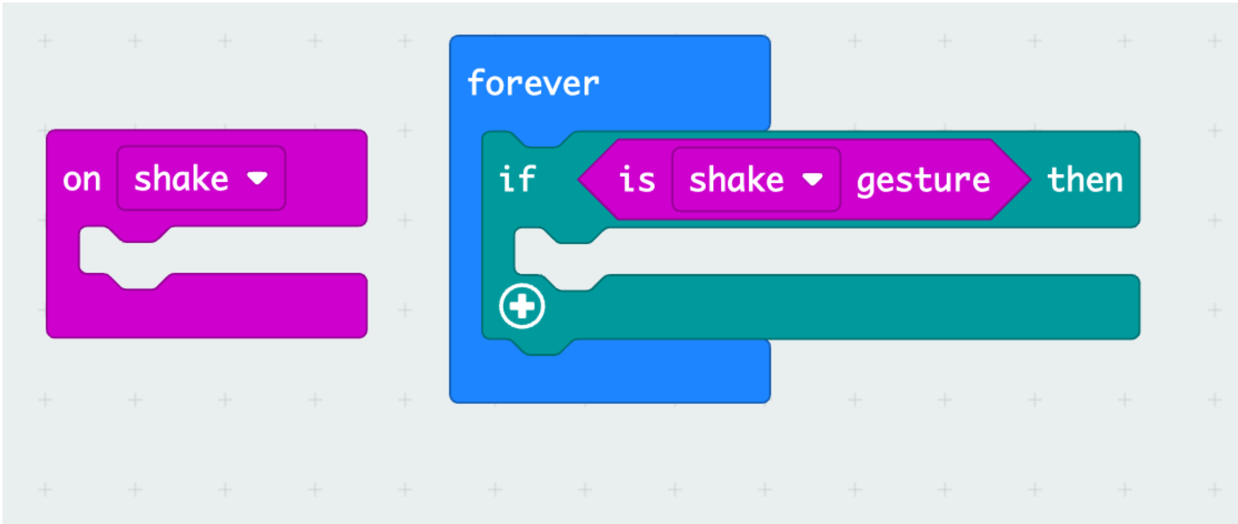
Background Information:

Coding:

In this project, coding concepts will be conditional statements and pin control.

Conditional Statement

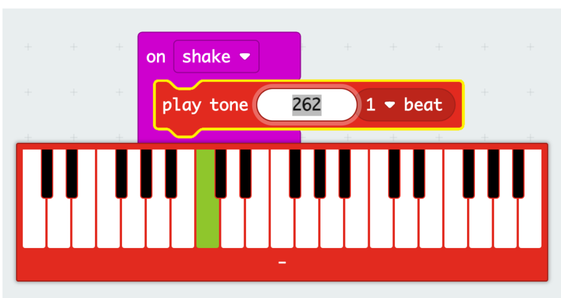
> The conditional statement for this project will be similar to the conditional statement learned from the name tag project. The difference is that the condition for the name tag project is which button is pressed; in this project, the condition will be whether the accelerometer is shaken or fallen based on the choices.
>
> You can ask students to try to rewrite the accelerometer condition block into an if-condition statement as a practice and review if time is allowed.

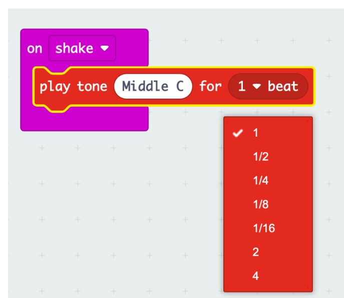


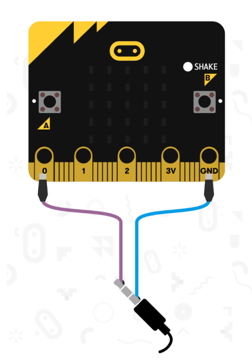
Pin Control

Notice: The new version micro:bits (V2) have on-board speakers which don't require connecting external speakers with pins.

To play a sound on a micro:bit, you need to decide the tone and its frequency.







The pins used in this project are GND pin and 0 Pin as indicated in the image to control the external speaker.

GND pin: attaches to ground in order to complete a circuit.

0 pin: 0: General purpose digital input and output with analogue to digital convertor (ADC).

In this case, the sound signal, which is the tone and frequency decided from the code, and power will be sent out from pin 0 to the speaker and attached to the ground pin to complete the circuit. (**Notice:** We assume students will learn basic circuits concepts from other group's course design and these will not be discussed in our class)

Supplies/Budget:

Material	Type	Budget
Tangible Coding Pieces (Tilt alarm)	Reuseable	Birch Wood Board: $4 (2 pieces) Acrylic Board: $4 (The whole kits need 1 ¼ inch acrylic which costs $16) Laser Cutter fee: Unknown (Free at NYU labs)
Micro:bit	Reuseable	micro:bit: $15 per each
Buzzer	Reuseable	buzzer: $1
Small Alligator Clip to Female Jumper Wire	Reuseable	Alligator Clip: $1.5 (2 pieces)
Materials for decorating	Consumable	Not limited | Depends on (Ex : Fabric, Lace, Ribbons, Paper, Beads, Clay, Pape…)

Steps:

Review (15 mins)	In groups, put the tangible pieces in the container together. Write about personal understanding of each block on the back of the pieces.
Brainstorming (15 mins)	In groups, discuss and brainstorm ideas about the scenarios they want to put a tilt alarm on. Use the tangible coding pieces as a prototype tool to decide what conditions and parameters they want for their design.
Making and documentation (40 mins)	Upload the code to micro:bit and make the tilt alarm based on their design. Document the process and share reflections.

Flexibility:

Tangible Coding Pieces

We understand that laser cutters might not be available to the program and materials are expensive. In this case, we create a paper version as another option.

Instructors can provide students with scissors to cut out the shape and color pens to color the blocks based on the makecode standard to promote understanding of blocks and digital interfaces.

Assessment:

Formative: Review Activity - Check if their written understanding is correct.

Summative: Students' micro:bit sensors should work as expected.

Lesson 7 - Cooking Safety I: What is the design for cooking safety

Lesson Overview:

Students discuss the unsafe factors in the kitchen and classroom collaboratively to find out some potential solutions before planning, creating and testing a heat sensor using the micro:bit.

Time: 60-75 mins

Learning Goals:

Students will recognize and identify cooking safety issues and potential solutions with micro:bit.

Learning Objectives:

- To be aware of and describe potential safety problems in kitchen and classroom settings.
- To be able to explain what a thermometer is and how it works.
- To be able to interpret what pin control is and correctly apply the codes.

Topic Area: Cooking safety

Background Information:

The current study shows that leading causes of accidental injury at home are burns, drowning, suffocation, choking, poisonings, falls, and firearms. Burns and fires are the fifth most common cause of accidental death in children and adults, and account for an estimated 3,500 adult and child deaths per year. However, nearly 75% of all scalding burns in children are preventable.

Children are so often busy playing and having fun, they tend to pay less attention to when they are becoming too hot or too cold until problems occur. It is important to protect children from heat and cold exposures that may cause them illness or injury.

During the last 30 years, burn injuries have decreased because of Increased use of smoke detectors. Also, new technology will help prevent tragic accidents at home. Micro:bit has an on-board thermometer sensor which can measure the degree of hotness and coolness.

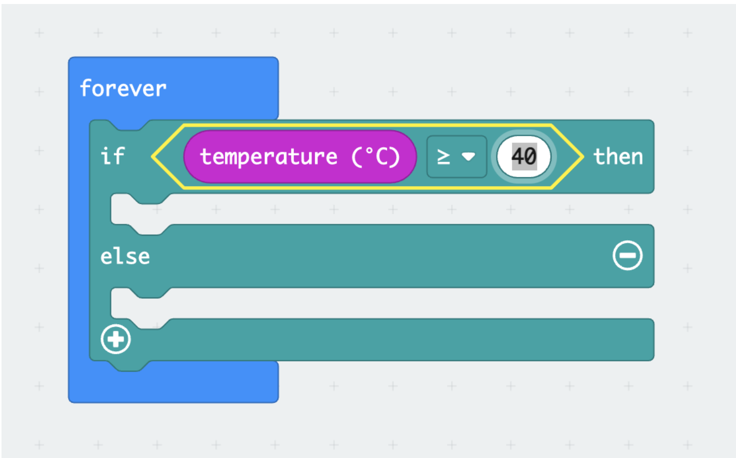
Design and make a thermal warning system with micro:bit. It prevents heat accidents that can happen in the kitchen in advance.

Hint: can be attached to a stick or gloves in the kitchen; students can detect hotness or coldness before they touch or grab the cooking tools or food. Try to be creative about where and how it could be used.

Coding:

In this project, coding concepts will be conditional statements and micro servo.

Conditional Statement

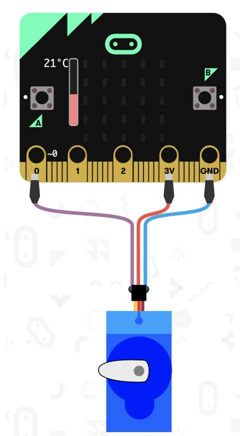


The conditional statement for this project will be similar to the conditional statement learned from the classroom safety. In this project, the condition will be whether the temperature sensor reacts to the above 40°C or not.

Students rewrite the temperature input block to customize the conditional block.

Servo control

To run a servo motor on a micro:bit, you need to decide how much the servo motor rotates between 0 degrees and 180 degrees.

Pin 

Control

The pins used in this project are GND pin, 0 Pin and 3V pin as indicated in the image to control the servo motor.

GND pin: attaches to ground in order to complete a circuit.

0 pin: General purpose digital input and output with analogue to digital convertor (ADC).

3V pin: 3 volt power output; 3V pin is power output to power servo motor

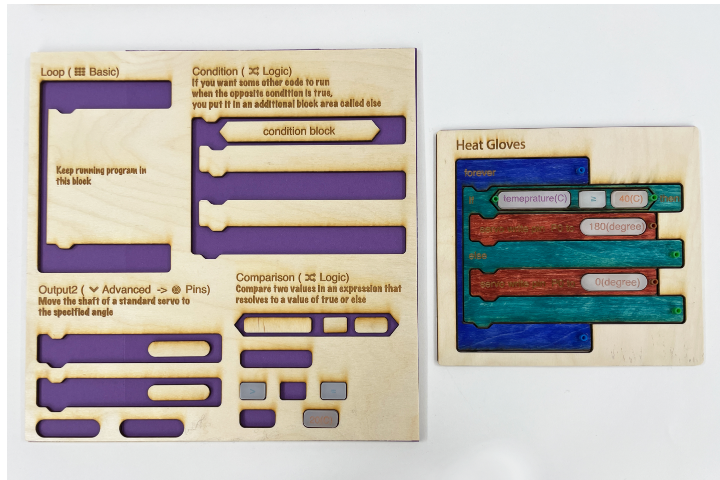
In this case, the servo motor, which is the value can be decided from the code, the power will be sent out from 3V and attached to the ground pin to complete the circuit. (**Notice:** We assume students will learn basic circuits concepts from other group's course design and these will not be discussed in our class)

Supplies/Budget:

Material	Type	Budget
Tangible Coding Pieces (Tilt Alarm)	Reuseable	Birch Wood Board: $4 (2 pieces) Acrylic Board: $4 (The whole kits need 1 ¼ inch acrylic which costs $16) Laser Cutter fee: Unknown (Free at NYU labs)
Heat sensing gloves Prototype	Reuseable	micro:bit: $ 5 Micro servo: $ 6 Jumper wire: $ 3
Paper and Pens	Consumable	$10

Steps:

Introduction (15 mins)	Introduce some facts about cooking accidents. In groups or pairs, invite students to consider and share the main problems around cooking safety for students.
How does an accelerometer work? (15 mins)	Talk about what a thermometer is and how it works. Give groups paper and pens and ask them to brainstorm potential ideas about where the alarm could be attached to– encourage them to think creatively. Present the heat sensing gloves prototype made by the instructor. The prototype making guide can be found here.
Introduce Coding Concepts for the Tilt Alarm (35 mins)	Introduce how to use pins to connect the servo motor and let students figure out how they can write the conditional statement with the tilt alarm tangible coding board. Explain the meaning of each tangible piece used for the tilt alarm. In groups, let students play with the tangible piece and put

	all the pieces together in the code container.  Ask students to explain the finished code to each other to ensure they understand the meanings of the order.

Flexibility:

Discussion on cooking safety

The topic can be extended to a broader scope. You could ask them about what are some unsafe factors they find in the kitchen and invite them to come up with a solution. The solution does not have to be related to the use of micro:bits and the intention for this discussion is to raise their awareness of in-school safety.

Tangible Coding Pieces

We understand that laser cutters might not be available to the program and materials are expensive. In this case, we create a paper version as another option.

Instructors can provide students with scissors to cut out the shape and color pens to color the blocks based on the makecode standard to promote understanding of blocks and digital interfaces.

Assessment:

Formative: students successfully come up with the right order of codes.

Summative: students can be able to explain why they place the codes this way.

Lesson 8 - Cooking Safety II: Create a heat sensor with Micro:bit

Lesson Overview:

Students will apply the coding knowledge they learned from the previous lesson and design the heat sensor using micro:bit.

Time: 60-75 mins

Learning Goals:

Students will apply the coding knowledge they learned from the previous lesson and design the heat sensor using micro:bit.

Learning Objectives:

- To connect the servo motor into their group designs.
- To differentiate the functions of different pins (GND, 3V, Pin etc.)

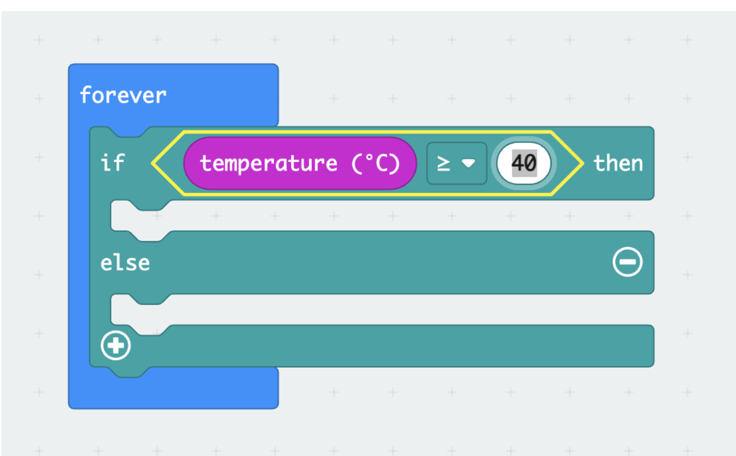
Topic Area: Cooking safety

Background Information:

Coding:

In this project, coding concepts will be conditional statements and micro servo.

Conditional Statement

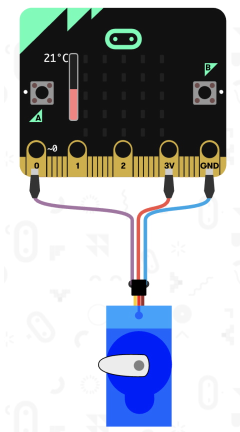


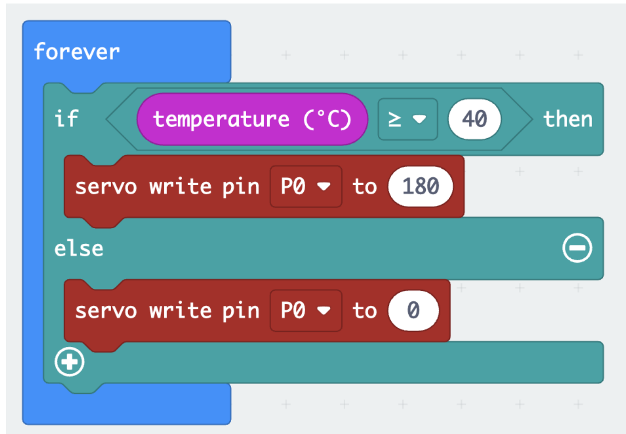
The conditional statement for this project will be similar to the conditional statement learned from the classroom safety. In this project, the condition will be whether the temperature sensor reacts to the above 40°C or not.

Students rewrite the temperature input block to customize the conditional block.

Servo control

To run a servo motor on a micro:bit, you need to decide how much the servo motor rotates between 0 degrees and 180 degrees.

Pin 



Control

The pins used in this project are GND pin, 0 Pin and 3V pin as indicated in the image to control the servo motor.

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0 pin: General purpose digital input and output with analogue to digital convertor (ADC).

3V pin: 3 volt power output; 3V pin is power output to power servo motor

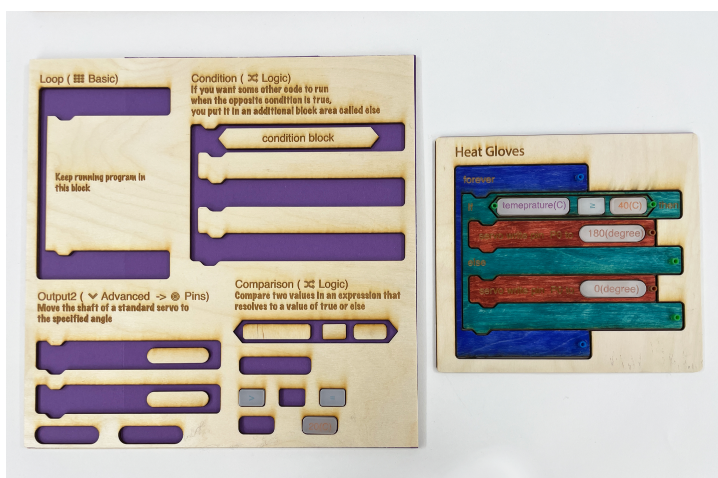
In this case, the servo motor, which is the value can be decided from the code, the power will be sent out from 3V and attached to the ground pin to complete the circuit. (**Notice:** We assume students will learn basic circuits concepts from other group's course design and these will not be discussed in our class)

Supplies/Budget:

Material	Type	Budget
Tangible Coding Pieces (Tilt Alarm)	Reuseable	Birch Wood Board: $4 (2 pieces) Acrylic Board: $4 (The whole kits need 1 ¼ inch acrylic which costs $16) Laser Cutter fee: Unknown (Free at NYU labs)
Heat sensing gloves Prototype	Reuseable	micro:bit: $ 5 Micro servo: $ 6 Jumper wire: $ 3

Paper and Pens	Consumable	$10

Steps:

Introduction (15 mins)	Introduce some facts about cooking accidents. In groups or pairs, invite students to consider and share the main problems around cooking safety for students.
How does an accelerometer work? (15 mins)	Talk about what a thermometer is and how it works. Give groups paper and pens and ask them to brainstorm potential ideas about where the alarm could be attached to– encourage them to think creatively. Present the heat sensing gloves prototype made by the instructor. The prototype making guide can be found here.
Introduce Coding Concepts for the Tilt Alarm (35 mins)	Introduce how to use pins to connect the servo motor and let students figure out how they can write the conditional statement with the tilt alarm tangible coding board. Explain the meaning of each tangible piece used for the tilt alarm. In groups, let students play with the tangible piece and put all the pieces together in the code container.  Ask students to explain the finished code to each other to ensure they understand the meanings of the order.

Flexibility:

Discussion on cooking safety

The topic can be extended to a broader scope. You could ask them about what are some unsafe factors they find in the kitchen and invite them to come up with a solution. The solution does not have to be related to the use of micro:bits and the intention for this discussion is to raise their awareness of in-school safety.

Tangible Coding Pieces

We understand that laser cutters might not be available to the program and materials are expensive. In this case, we create a paper version as another option.

Instructors can provide students with scissors to cut out the shape and color pens to color the blocks based on the makecode standard to promote understanding of blocks and digital interfaces.

Assessment:

Formative: students successfully come up with the right order of codes.

Summative: students can be able to explain why they place the codes this way.

Lesson 9 - Final Project I: Brainstorm the ideas

Lesson Overview:

Students will review what they learned from previous 4 micro:bit projects and brainstorming their final project ideas.

Time: 60-75 mins

Learning Goals:

Students will summarize the concepts learned from previous lessons and build solutions with micro:bit for daily life safety problems.

Learning Objectives:

- To explain and memorize how to use and control different on-board sensors including light, temperature, and accelerometer sensors.
- To identify different output options in micro:bit
- To relate daily life problems with potential solutions by using the microcontroller.
- To prototype the design with tangible coding pieces.

Topic Area: Safety Design

Background Information:

Topic area:

The main purpose of this final project is to invite students using all the knowledge from previous lessons and solving a new problem spec.

Since the topic will be fully decided by the instructor him/herself, background information is not provided here.

Coding:

Possible coding concepts can be used in this project: conditional statements including button control, accelerometer control, if statement, and if-else statement, loops, and pin controls. Detailed explanation could be found from previous projects.

Supplies/Budget:

Material	Type	Budget
Tangible Coding Pieces (4 kits)	Reuseable	Birch Wood Board: $16 ¼ inch Acrylic Board:$16 Laser Cutter fee: Unknown (Free at NYU labs)
Materials for decorating	Consumable	Not limited | Depends on (Ex : Fabric, Lace, Ribbons,

		Paper, Beads, Clay, Pape…)

Steps:

Review (15 mins)	In groups, go over the previous projects' documentations and briefly identify input sensors and output used in each project.
Topic Introduction (15 mins)	Introduce the topic scenario and background information and show some existing examples.
Brainstorming(40 min)	In groups, let students discuss ideas on potential solutions. In groups, use tangible coding pieces to help decide what sensors and output they need for the final project, and create the code for the project. In groups, think about the design and materials needed for their final prototypes.

Flexibility:

Topic Domain

The main topic will be decided by the instructor based on background, interest, locations, and other factors. It can be expanded from previous projects like night safety, classroom safety, and cooking safety. Some other potential topics could be home safety, swimming pool safety, and etc..

Tangible Coding Pieces

We understand that laser cutters might not be available to the program and materials are expensive. In this case, we create a paper version as another option.

Instructors can provide students with scissors to cut out the shape and color pens to color the blocks based on the makecode standard to promote understanding of blocks and digital interfaces.

Assessment:

Formative: Review Activity - Check if they can recall the concepts from previous lessons.

Summative: Students should deliver a design with at least one sensor and one output.

Lesson 10 - Final Project II: Build the project and showcase

Lesson Overview:

Students will finish their final project design and showcase.

Time: 60-75 mins

Learning Goals:

Students will be able to build a micro:bit project.

Learning Objectives:

- To ensure the micro:bit fully work as expected
- To connect sensor and output with the specific application scenarios
- To gain crafting skills by making the design more accessible in the scenario

Topic Area: Safety Design

Background Information:

Topic area:

The main purpose of this final project is to invite students using all the knowledge from previous lessons and solving a new problem spec.

Since the topic will be fully decided by the instructor him/herself, background information is not provided here.

Coding:

Possible coding concepts can be used in this project: conditional statements including button control, accelerometer control, if statement, and if-else statement, loops, and pin controls. Detailed explanation could be found from previous projects.

Supplies/Budget:

Material	Type	Budget
Tangible Coding Pieces (4 kits)	Reuseable	Birch Wood Board: $16 ¼ inch Acrylic Board:$16 Laser Cutter fee: Unknown (Free at NYU labs)
Micro:bit	Reuseable	micro:bit: $15 per each

Materials for decorating	Consumable	Not limited | Depends on (Ex : Fabric, Lace, Ribbons, Paper, Beads, Clay, Pape…)

Steps:

Building Projects (45 mins)	In groups, rebuild the tangible coding pieces and upload the code to their micro:bits. In groups, finish up the design by adding decorating materials.
Showcase (25 mins)	Each group showcase and present their project ideas by explaining the scenario, how the sensor and output can help, and some reflections from the project.

Flexibility:

Topic Domain

The main topic will be decided by the instructor based on background, interest, locations, and other factors. It can be expanded from previous projects like night safety, classroom safety, and cooking safety. Some other potential topics could be home safety, swimming pool safety, and etc..

Tangible Coding Pieces

We understand that laser cutters might not be available to the program and materials are expensive. In this case, we create a paper version as another option.

Instructors can provide students with scissors to cut out the shape and color pens to color the blocks based on the makecode standard to promote understanding of blocks and digital interfaces.

Assessment:

Formative: Review Activity - Check if they can recall the concepts from previous lessons.

Summative: Students should deliver a design with at least one sensor and one output.