MISSION 7: Personal Billboard	Time: 60-90 minutes

Overview:

Have you ever made a sign to post on a door or wall? How about a name badge to wear? Or a cap or t-shirt with a message or slogan on it? In this project, students build a device that lets them display images or text, and use buttons to scroll through the items to display a particular occasion or mood.

Cross Curricular:

- **MATH:** Students learn the six different comparison operators. An extension lesson can have students use comparison operators with numbers and in various math scenarios.
- **CROSS-CURRICULAR:** Students learn about lists. Take time in one of your core subjects to brainstorm how you can use lists. Or utilize lists in some way with another subject.
- Supports **language arts** through reflection writing

Materials Included in the learning portal Teacher Resources:

Mission 7 Slidedeck

The slide deck is for teacher-led instructions that let you guide students through the material using the slides. It is an alternative to the students reading a lot of instructions in CodeSpace. The slides mirror the instructions, with simplified language that is chunked into smaller sections at a time. The information is shown on slides with “Objective”. The tasks to complete are on slides with “Mission Activity''.

Mission 7 Workbook

The workbook can be used instead of slides for student-led or independent work. It is an alternative to students reading a lot of instructions in CodeSpace. It mirrors the instructions (and the slide deck), with simplified language that is chunked into smaller sections at a time. Each objective is on its own page. The tasks to complete are labeled “DO THIS” and have a robot icon next to it.

Mission 7 Log

This mission log is the worksheet for students to complete as they work through the mission. It should be printed and given to each student before the mission starts. They write on the mission log during the assignment and turn it in at the completion of the mission (assignment).

Mission 7 Lesson Plan

The lesson plan comes from the original CodeX Teacher Manual and is included here for easy reference.

Mission 7 Remix Folder

Following Mission 7, students should complete a remix of their code.

Additional Resources:

- Mission 7 Solution (Billboard)
  - A code solution to Mission 7 in a text file.
- Mission 7 Review Kahoot

Formative Assessment Ideas:

- Exit ticket
- Mission log completion
- Completed program
- Mission 7 Review Kahoot
- Student Reflection

Vocabulary:

- **Index:** A number that keeps track of what choice should be displayed in a list.
- **Comparison Operators**: Operators that let you compare two values; the result is True or False. Comparison operators include: ==, <, >, <=, >=, !=

- **List:** A sequence of items you can access with an index.

Review from Mission 6:

- **Increment:** Increase the value of a variable by a set amount (example: num = num + 1)
- **Decrement:** Decrease the value of a variable by a set amount (example: num = num - 1)

Preparing for the lesson:

Students will use the Codex throughout the lesson. Decide if they will work in pairs or individually.

- Look through the slide deck and workbook. Decide what materials you want to use for presenting the lesson. The slide deck can be projected on a large screen. The workbook (if used) can be printed or remain digital through your LMS.
- Be familiar with the Mission Log (assignment) and the questions they will answer.
- Print the Mission Log for each student.
- If you have a word wall, or another form of vocabulary presentation, prepare the new terms. Review a few terms from earlier missions.
- The mission program does not need to be portable. If you want students to use the CodeX without a cable, then have batteries available.

Lesson Tips and Tricks:

💡 **Teaching tip:**

You can use a variety of discussion strategies to get the most engagement from your students. For example, you can have students write their answers before asking anyone for an answer. You can use one of many think-pair-share methods. You can have students write their answer and share with someone, and then have other students share answers they heard from their peers. You can randomly select students to answer.

🧑‍🤝‍🧑 Pre-Mission Discussion (Slide 2, page 1):

Students can write in their log first and then share, or discuss first and then write in their log.

There are two questions for the pre-mission. There aren't any "right" answers here. The purpose is to get them thinking about wearable technology. Also, there are real-world applications to what they are learning.

- If you could show what you like or your mood by displaying something, what would you display?
  - Possible answers: favorite color, color that mimics a mood, favorite saying, favorite animal or sports tea, etc.
- What type of clothing would you display your message on?
  - Possible answers: hat, belt, necklace or jewelry, t-shirt, coat

💻 Mission Activities:

Most of this lesson is on the computer, writing code to make a variable speed heartbeat.

- Each student will complete a Mission Log.
- Students could work in pairs through the lesson, or can work individually.
- Students will need the CodeX and USB cable.

💡 **Teaching tip: Objective #1** -- Slides 3-5, Pages 2-3

This objective is all review. Students program two buttons to display images.

💡 **Teaching tip: Objective #2** -- Slides 6-12, Page 4-7

There is a lot to this objective. Students learn about a variable for index and comparison operators. They use == for “equals” in particular, but others are shown in a sidebar. A reminder of built-in images is given. Students add four “if” statements to display four different images, using a variable “choice” as an index. Take your time here and see if there is any confusion about what students are doing. Students are encouraged to do the code on their own, but the solution is provided if needed on the next slide or page.

💡 **Teaching tip: Objective #3** -- Slides 13-16, Pages 8-9

Students review increment and decrement from Mission 6. They change the code for BTN_L. Then students use the debugger to watch the value of “choice” change as BTN_R and BTN_L are pressed. You may need to demonstrate the debugger.

💡 **Teaching tip: Quiz** -- Slide 17, Page 9

Students take a ❓ short quiz. The 3 Quiz questions are below. You can decide if you need to go over the question with your students.

💡 **Teaching tip: Objective #4** -- Slides 18-23, Pages 10-12

During the debugging in Objective #3, and also in the quiz, students realize that choice can keep changing, but the image stops at the beginning or end. In this objective students learn how to use code to “wrap-around” to the beginning or end of the images. They will include an “if” statement inside the “if” statement they already have and assign a specific value to “choice.” There is a lot here, so take your time and make sure students understand the code for wrap-around. The code for BTN_R is given, but not BTN_L. They should be able to generate the code on their own, but make sure before they continue. The code for both buttons should look like this:

```
if buttons.was_pressed(BTN_L):
    choice = choice - 1
    if choice < 0:
        choice = 3

if buttons.was_pressed(BTN_R):
    choice = choice + 1
    if choice > 3:
        choice = 0
```

💡 **Teaching tip: Objective #5** -- Slides 24-29, Pages 13-16

The definition of a list is introduced. A list is another data type, so students now know 6 data types. You may want to take time to review them. Some important concepts are introduced here: the index for each item, how to create a list, and how to access one item in a list. The code for creating and accessing is very similar: they both use [ ]. You may want to review the differences between them.

Then students add a list to their code and use it in the program. They must delete the four “if” statements they have for choice. Check that they do this. Their code will be much shorter than before.

💡 **Teaching tip: Objective #6** -- Slides 30-33, Pages 17-18

Students learn about “magic numbers”, which are just literal values in the code that seem like magic because they don’t really have context. Students will replace the “magic number” of 3 by using a CONSTANT. This concept is not covered. You can optionally discuss it, or know the answer if a student asks. The CONSTANT is in all caps because it denotes a variable that doesn’t change its value during program execution. In Python, it doesn’t have to be capitalized, but that is the convention. Also, review that the last index is one less than the length (or number of items) because computers start counting at 0, not 1.

💡 **Teaching tip: Quiz** -- Slide 34, Page 18

Students take a ❓ short quiz. The 1 Quiz question is below. You can decide if you need to go over the question with your students. It is about subtracting one from the length of the list to get the last index.

💡 **Teaching tip: Objective #7** -- Slides 35-36, Page 19

Students add a text string to the list. This objective is fairly straightforward. The instructions show the text string added to the beginning of the list, but really it can be anywhere. Also, an example of the list shown vertically instead of horizontally is shown. This is optional, but it can make the code easier to read. Students need to remember the comma, separating the items. They press enter after each comma and indent as needed to get a readable list. The last item should not have a comma!

💡 **Teaching tip: Objective #8** -- Slides 37-38, Page 20

Students add a color to the list. This objective is fairly straightforward, like the last one. Once again, the color is shown at the beginning of the list but it can be anywhere.

🗝️ **NOTE:** Students will get an error. This is to be expected. They will fix the error in the next objective.

💡 **Teaching tip: Objective #9** -- Slides 39-45, Pages 21-24

This objective has several small parts.

- First, they review RGB values for a color, like GREEN. Hint: the RBG tuple is (0, 255, 0)
- Then students use the “type” command in the console panel to check data types of different values. Slide 43, or page 23, shows a screenshot of all values and their data types, so give you an idea of what students should be doing.
- Then students add an “if” statement to their code to fix the error from the last objective. At this point, students have met the objective. But another task is given to students so they can really try out their personal billboard.
- Finally, students add more colors, text and images to the list. The code should work for any of those three data types. This isn’t required to complete the mission, but it should make it interesting and engaging to students to personalize their billboards and show their work to their friends.

💻 Mission Complete:

This mission ends with a completed, working program that will display colors, text and images. You need to decide how you will use the program for assessment. You could:

- Go to each student and check-off their code
- Have the students download their code to a text file and turn it in using your LMS
- Have students print their code (either download and then print the text file, or print a screenshot)
- Have students switch computers and run each other’s code. Fill out a simple rubric and turn in to teacher
- Any other way that works for you

🧑‍🤝‍🧑 Post-Mission Reflection:

The post-mission reflection asks students to think about real-world applications for lists. You can change the question if there is something else you want to emphasize with your students.

- What are some coding projects you are interested in that might use a list?
  The answers will vary – no wrong answers

End by collecting the Mission Log and any formative assessment you want to include.

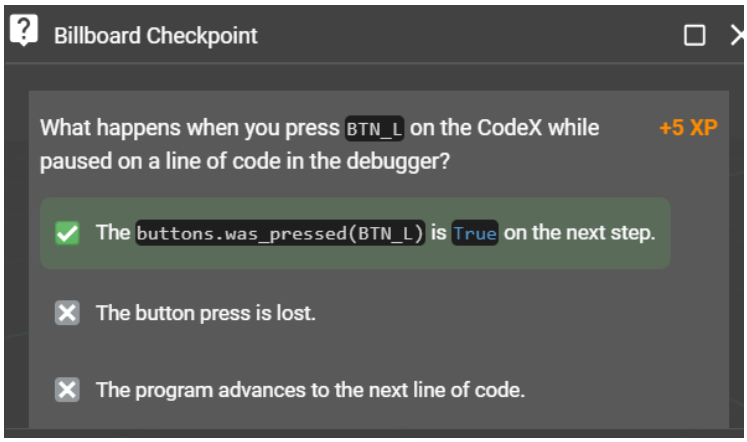
💻 IMPORTANT Clearing the CodeX:

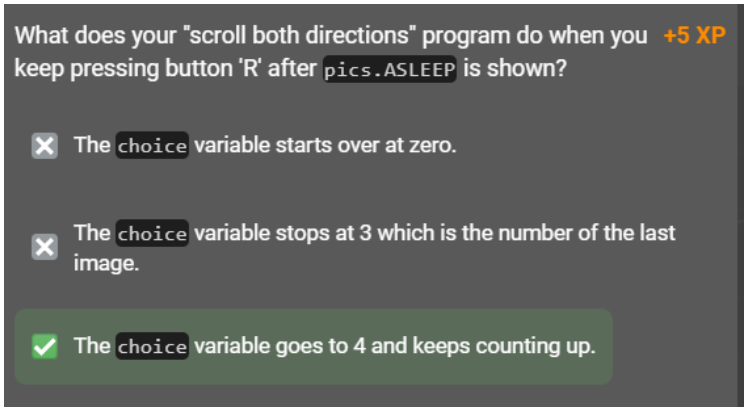
The students have already created a “Clear” program. Students should open and run “Clear” at the end of each class period.

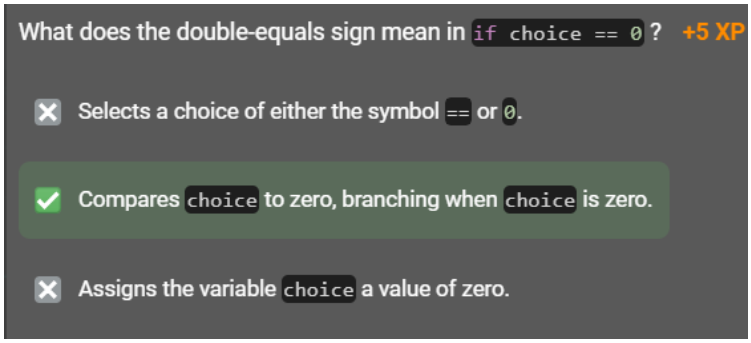
SUCCESS CRITERIA:

- ❏ Program the buttons to scroll through a series of images.
- ❏ Change the code by using a list to make the program easy to add lots more images.
- ❏ Mix text messages, colors and images in the list
- ❏ Add an if statement that will correctly display a text string, image or color

❓ Quiz #1 Questions







❓ Quiz #2 Questions