STREAM STARTER LESSON 4
CODING BASICS

What students will learn
- How can we program Ozobot?
- What are the basic steps of programming and how does this work with Ozobot?
- Analyze and decompose geometric figures and translate them into moves for Ozobot

Topics
- Computer science: basic principles of coding and debugging
- Robotics: programming Ozobot and executing the program
- Math: geometry (right angles), decomposing a geometric drawing into a series of movements

Dance challenge
Write, debug and run a program to make Ozobot dance a specific step

Real-life connection
Learning the basics of programming

Materials
- Ozobots (about 1 per group of 3 students), calibrated and charged
- digital tablet (iOS or Android operating system), charged and screen brightness set to 100% (one tablet per ozobot/group of students)
- OzoGroove app (download for free on iOS app store or google play, go to settings and select: "keep tablet awake")
- printout #1, one per group
- Optional: printout of lesson PDF, one per group, if students are learning self-guided

Common Core Standards

CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them.

CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively.

CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically.

CCSS.MATH.CONTENT.4.G.A.1 Draw and identify lines and angles, and classify shapes by properties of their lines and angles.

Age
Grades 3-5

Ozobot skill level
Beginner

STEM topics
- Computer science: basic principles of coding and debugging
- Inter-disciplinary concept: use robotics to study programming and math

Estimated duration
60 min

LESSON

1. Let Ozobot dance!

Today's lesson is all about making Ozobot move on its own - without the lines! How does this work? How will Ozobot know where to go? We have to use codes to tell Ozobot what to do. You already know that there are codes to tell Ozobot to turn left, speed up, turn around and so on. These codes only work if Ozobot is following a line. But there are also codes that tell Ozobot to move forward, spin around, change color, etc, and Ozobot does not need to see any line to execute them.

These codes are only flash codes though, so we will have to use a tablet to be able to use them.

Get your tablet ready and make sure that the screen brightness is set to 100%, i.e. as bright as you can make it. Open the OzoGroove app and calibrate Ozobot on your tablet (go to "Ozobot Tune up" and follow the directions to "Calibrate sensors"). Now, go back to "Home" (i.e. the main menu) and press "Dance!".

You are now on the dance floor. Before Ozobot can start dancing, we first have to pick a dance and then teach Ozobot that dance.

Press "Select Dance" then "load from local" and pick "3 OZO-STEP-IT-UP-demo" in the list. All these dances come with a song and a sequence of dance steps. Wait until the "Loading…" sign disappears. Now, Ozobot doesn't know about any of the moves in that dance yet, so how can we let Ozobot know what to do? To do this, choose any of the pods on the dance floor and tap it to activate. The pod will turn white and you have to place Ozobot on the pod such that the middle sensor is in the center of the pod (If you skipped the first lesson, turn Ozobot upside-down and you will find the five sensors sitting in the openings. The middle sensor is the one that can see colors, so that's the one we will be using). Now press the "Load Ozobot" button on the right. The pod you selected will start flashing colors and display "Loading Ozobot(s)" on the top of the screen. Ozobot should be stationary and flashing green. Wait until the flashing is done and the

dance title appears again on the top of the screen. Make sure not to move Ozobot while you are waiting!

What just happened here? Much like the flash codes, every move or instruction has a corresponding color sequence. Ozobot has been programmed at the factory to understand all these sequences. This is how we can tell Ozobot what moves to do. Since there are many moves in this dance, the color sequence is very long and you can see flashes of colors for a long time.

But now Ozobot knows the dance and all there is left to do is to start the music and to tell Ozobot to begin dancing.

Keep Ozobot on the pod and tap "Dance". A flash code will tell Ozobot to start dancing and so Ozobot does!

If the music is too loud, use the volume slider around the dance or pause/stop button to regulate the volume. Also, if Ozobot needs more space, feel free to lift Ozobot up and back down on any flat surface. Ozobot has the dance memorized, so the tablet is not needed at the moment. If you want to pause or stop the dance, place Ozobot back anywhere on the tablet before pressing pause or stop.

You can also try to let several Ozobots dance together (up to 5 on a tablet and up to 2 on a smart phone). You can have as many of the pods activated as you want, and the flash codes will be visible on all activated pods. Make sure to deactivate the pods if they're not needed anymore.

Try out another dance. Simply go through the same steps of selecting a dance, loading Ozobot and pressing "Dance".

You can see how different the flash codes work from what we have seen before. We are flashing a long sequence of codes to Ozobot all at once and we are doing this before Ozobot starts moving at all. Ozobot now remembers all of these, up to 500 of them, and then executes them, one after the other, when we give Ozobot the start sign.

2. Change the moves!

How are the moves put together? Let's see how it works for one of the dances we just tried out!

Go to "Home"/main menu and press "Dance Editor", which takes you to the screen in which you view and modify the moves you want to use. Choose "Load a Dance" in the popup window. Another window will appear and here choose "Load from Local". Pick "3 Ozo-Step-It-Up-demo."

There are a lot of different buttons and we will go through it together, but if you want a quick overview, take a look at printout #1.

Back on your tablet, take a look at the blue area in the center of the screen. This is the timeline and it holds all the moves and instructions. You can see individual moves in the timeline. They are the grey rectangles in the upper portion of the red timeline. You can scroll through the timeline in several ways:

1. Use the grey arrow buttons to the right and left of the timeline. Tapping on them will move just a bit forward or backward. Long pressing them will scroll forward/ backward a bit faster until you release your finger.
2. Use the "Prev Move" and "Next Move" button below the timeline. This will jump to the previous/next move if there is any.
3. Pan horizontally while holding a move.

Try any or all of these methods and look around to see what moves this dance is made of.

This is the dance you have seen Ozobot perform, but here it is broken down into very basic moves. They are arranged on the timeline and Ozobot will remember all these moves and dance them one after the other. Let's change the choreography a little bit. Above the blue box, you can see a whole bunch of buttons in two rows. Up on top are some that say "Lights", "Steps", "Shakes", etc. These are different kinds of moves and instructions and they are separated and grouped into different categories so you can find more easily what you are looking for.

Select the "Lights" button if it is not already and you will see all available options below. These are the colors that Ozobot can display while dancing. Select the color you like and drag and drop it into the timeline as the third item behind "start," just between "BLUE" and the first move "CIRCLE RIGHT BIG." You may have to scroll the timeline to the very beginning first to see the START. The color code will be inserted into the timeline and everything to the right will shift automatically.

Now let's see if Ozobot really shines in the new color at the start of the dance.

Find the "Dance!" button on the bottom right of the screen and press.
(Note: make sure to go directly to the the dance floor via the "Dance!" button on this screen. If you go back to the main menu first without saving your dance, then all changes will be lost.)

You are back on the dance floor. If you enter the dance floor like this from the editor, you don't have to select a dance - the one that you were working on is selected automatically.

So you can go ahead with loading Ozobot right away. Afterwards, press "Dance" as usual.

Did it work? Is Ozobot shining in the color you selected?

3. You are the choreographer now!

We have seen how good of a dancer Ozobot can be, now you are in charge of making Ozobot move.

Go to the main menu press the "Pro Dance Editor" button on the bottom of the screen. This is a different kind of editor with additional options for moves and instructions. There are many more options than in the "Dance Editor", but we will go through those together. Choose "Create a New Dance" in the popup - this time we will do everything from scratch!

Now select the music. Anything from the list is fine.

Let's start with a short dance move: **go forward, turn around, and go back to the start.** These moves are listed in printout #2 under "Move Exercise" so we don't forget what Ozobot shoud do.

How can we make Ozobot do this?

In the middle of the screen, you can see the red box with the timeline. It work exactly the same as in the dance editor that we have seen before. Now let's put some moves together. Above the red box, you can see a whole bunch of buttons. Up on top are some that say "Forward", "Backward", "Circles", etc. These are different categories just like in the other editor, only more of them. Use the arrow buttons on the sides or swipe to see all categories.

Select the "Forward" button if it is not already and you will see the available moves below:
"Forward 10", "Forward 5" and "Forward 30"
The different numbers are simply telling Ozobot how many units to move forward. Drag and drop "Forward 30" into the timeline. Try to drop it right next to the START in the timeline. This makes Ozobot start the move right away without a pause. If you have to readjust the move a bit, lift it slightly and drag it left or right within the timeline. And if you don't want a move in the timeline at all anymore, drag it outside the red box and it's gone.

We want Ozobot to turn around now. You decide if you want Ozobot to turn around going left or right. Find it in the "Left Turns" or "Right Turns" category and tap on it. You will see "Left 15" or "Right 45" and so on. The numbers tell Ozobot how many degrees to turn. Which one do you have to pick to make Ozobot turn around? Remember, 360 degrees is a full circle and turning around is a half circle, which means 360/2 = 180 degrees. See solution 1 at the end of the lesson.

Drag and drop the selected move into the timeline behind (i.e. to the right) of the "Forward 30" move. Try to move it as close as possible to the "Forward 30" move that is already there. We want Ozobot to do the moves one right after the other without a time delay in between them. You will see a green line underneath both moves if they are close enough together. This means that they are grouped together without a time delay in between.

So we have the instructions to move forward and turn around. We still have to get Ozobot back to the starting point. Which move do you have to use?

Choose the one you think you need and drop it behind the turn around code, again without a delay. See solution 2 at the end of the lesson.

Before we check if we got it right, let's save this dance so we can reuse it later. Tap "Save,"on the popup, tap the "Enter Dance Name" field and enter a name, then press "save."

Now let's check if Ozobot is really doing the right dance move. Tap the "Dance!" button and you will arrive at the dance floor again. Program Ozobot just like you did before and make Ozobot dance. Why is Ozobot repeating the moves over and over again? Look at the button right below the "Dance" button. It says loop dance and it should be set to "ON." Ozobot will repeat the move sequence indefinitely. If you want Ozobot to do the moves only once, tap the button to set it "OFF."

Did you get it right? If you have to change something, tap the "Back" button on the top left in the header which gets you back to the editor. Make the changes, save again and go back to the dance floor to try it out. Repeat until you got it right.

Congratulations! You have just written and run your first program! Let's review how this happened:

- Assembling the moves in the timeline is just like writing a program. All the instructions are put together, one after the other.
- Programing Ozobot is like compiling and installing your program. Ozobot would not be able to read and understand the moves in the timeline. Instead, they are translated into a series of flash codes which Ozobot can understand. This is what a compiler does: translating the written program into an executable. The compiled codes are now flashed to Ozobot so Ozobot is aware of the dance and can memorize it. This is like installing the executable.
- Pressing "Dance" is like running your program.
- And what about the going back and forth trying to make the program work correctly? That is called debugging and that's how you will spend most of your time when you are programming!

4. Make it a full dance!

What we have created so far is just a dance move and not a complete dance, so let's make one out of it. Go back to the editor. To make it more interesting, let's add another move to the dance we have so far. Add a 90 degree turn to the end of the dance, left or right - it's your choice. Make sure to add it without a delay again. Now go to the dance floor and try it out: load the dance into Ozobot and start.

Are you noticing that Ozobot sometimes doesn't take an exact 90 degree/right angle turn? This is because the wheels are not running at the same speed and that makes turning exactly at a right angle (or any exact angle for that matter) very hard. You can try to tune the motors (go to main menu -> tune up -> tune motors and follow the directions) and that may help a bit. But in the end, Ozobot may still be a little off when turning, but that's just like in a real dance!

Does Ozobot go with the beat of the music or does it look like the dancing is a bit off? Stop Ozobot and go back to the editor and find the speed category. Drag any of the speeds and drop it right in between start and the first move. Save the dance and try it out. Repeat until Ozobot is going at the speed that fits the music best.

Now Ozobot is dancing nicely! You have been refining and debugging your program to get it just right - like a real programer! This is called "Test as you write" and it's a very useful tool in programing. Instead of writing a complete program and then debugging it at the end, it's much better to write it in smaller pieces and test often as you add to your program.

Also, don't forget to save your dance often - it's probably a good idea to do this at least every time you go to the dance floor. You never know what may happen, you might accidentally exit the program or start a new dance without saving the old one and it would be a shame to loose a great dance.

Dance Exercise

Let's use everything we have learned so far to create another dance.

Go to the "Pro Dance Editor" again and start a new dance. Choose any music you like. Take a look at the "Dance Exercise" on handout #2 on which you will find an outline of a dance move. Your task is to recreate this dance move with Ozobot. In red, you can see the number of units each step is supposed to be. You can use 3 forward steps and one backward step. Try to recreate the dance steps first. See solution 3 at the end of the lesson.

After you are happy with the dance steps, you can now add any special moves you like. For example, you can try to include a 360 spin (turn) or change the color of Ozobot's LED light, or make Ozobot look to the left and right at any point of the dance. It's up to you. See solution 4 at the end of the lesson.

When you're done putting the entire sequence together, choose the speed to match Ozobot's movements with the beat of the music. Don't forget to set the "Loop Dance" to on and watch Ozobot dance!

Solutions

Solution 1: "Left 180" or "Right 180"

Solution 2: "Forward 30"

Solution 3:
- forward 10
- right turn 90
- forward 30
- backward 30
- right turn 90
- forward 10

Solution 4: there are many options for this, one of them is:
- orange
- forward 10
- right turn 90
- forward 30
- green
- backward 30
- right turn 90
- forward 10
- backward 5
- forward 5

Quick Guide

Categories

Moves for the selected category, drag and drop into timeline

Zoomed timeline view, scroll by holding and panning a move]

Timeline scroller, tap to scroll a little, hold to continue scrolling

Complete view of the timeline [yellow indicates moves]

Skip to next move

Try it out on the dance floor

ozobot

HELP

295 MOVES LEFT

3 OZO-STEP-IT-UP - demo

OZO MOVE-IT

STEPS SHAKES TWISTS SPINS

LIGHTS

CYAN MAGENTA YELLOW RED GREEN BLUE ORANGE PINK

START

CYAN BLUE

CIRCLE RIGHT BIG CIRCLE LEFT BIG

NEXT MOVE

PREV MOVE

NEW LOAD

SAVE DANCE!

0:00

0:45 1:00

DANCE EDITOR

Timeline

Timeline scroller, tap to scroll a little, hold to continue scrolling

Skip back to previous move

Music playback controls

Volume

Save the dance (to your device or share it)

Load another dance

Create a new dance

MOVE EXERCISE

MAKE OZOBOT DO THE FOLLOWING MOVES:

GO FORWARD
TURN AROUND
GO BACK TO THE START

*   *   *

DANCE EXERCISE

USE: 3 FORWARD STEPS
         1 BACKWARD STEP
         AND THE NECESSARY TURNS

30

10

START/END