Advancing with Coding

LEGO® Education Unit for

LEGO® Education Coding Express

Unit Introduction

This unit allows students to develop their computational thinking skills and build foundational computer science knowledge. Students will investigate more advanced coding concepts through creating new tracks. Students will also further investigate the hardware and software used.

Students are encouraged to ask questions and test their answers as they build skills and knowledge in the following areas:

- Exploring algorithmic concepts through physical coding
- Exploring how to break problems down into smaller chunks
- Understanding the difference between hardware and software
- Using hardware to explore the science idea of how pushes and pulls affect movement
- Building communication, problem-solving skills, collaboration, and creativity skills
- Working together to solve a simple problem according to a need

Unit Learning Promise

In this unit, your students will explore the interaction of hardware and software as well as conditional statements through designing and creating train tracks that include different paths. Students will program their train using action bricks that allow for physical coding as well as using the Coding Express App to control the action of the train as it moves through different tracks. Students will learn how to plan for the creation of a program using Coding Express track and action bricks to perform specific actions.

Investigation Questions:

How does the Coding Express train work? How can I change the path of the train using the track? How can I change the behavior of the train without touching it? How can I create a program to share an idea or solve a problem?

Unit Lessons

Lesson 1	Lesson 2	Lesson 3	Lesson 4
How Does It Work? Time: 45 minutes	Y-Shaped Track Time: 45 minutes	Journey–Trouble on the Road Time: 45 minutes	Story Maps Time: 60 minutes

Assessment

We recommend assessing students on various skills throughout the unit.

- Use the progression of lessons as an opportunity to provide on-going feedback to prepare students for success for the open-ended project at the end of the unit.
- Each lesson includes a recommendation for teacher observations, student self- assessment, evaluation of success.

Unit Standards

CSTA

- 1A-CS-02 Use appropriate terminology in identifying and describing the function of common physical components of computing systems (hardware).
- 1A.CS-03 Describe basic hardware and software problems using accurate terminology.
- 1A-AP-10 Develop programs with sequences and simple loops, to express ideas or address a problem.
- 1A-AP-12 Develop plans that describe a program's sequence of events, goals, and expected outcomes.

Integrated Standards

CSTA

- 1A-CS-01 Select and operate appropriate software to perform a variety of tasks, and recognize that users have different needs and preferences for the technology they use.
- 1A-AP-11 Decompose (break down) the steps needed to solve a problem into a precise sequence of instructions.
- 1A-AP-14 Debug Identify and fix) errors in an algorithm or program that includes sequences and simple loops

CCSS ELA

- SL.K.3 Ask and answer questions in order to seek help, get information, or clarify something that is not understood.
- SL.K.4 Describe familiar people, places, things, and events and, with prompting and support, provide additional detail.
- SL.K.5 Add drawings or other visual displays to descriptions as desired to provide additional detail
- W.K.3 Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic.

CCSS Math

- MP1 Make sense of problems and persevere in solving them

LEGO® Education Coding Express

How Does It Work?

Investigate the functions of the hardware and software for LEGO® Education Coding Express.

STEM, Creative Exploration, and Computer Science

K	30–45 min.	Intermed.

Prepare

- Before the lesson, make sure the LEGO® Education Coding Express sets are ready to use.
- This lesson is designed to be used with the LEGO® Education Coding Express App. Download the app at https://education.lego.com/en-us/downloads/early-learning/software and pair it with trains in the sets.
- Locate a piece of black fabric or construction paper.
- **Vocabulary:** hardware, software, sensor, app

Engage

- Show students the Coding Express train.
- Ask them how they think the train works with the track.
- Students could draw a picture and/or use words to predict how they think the Coding Express train interacts with the action bricks.

Explore

- Have students test the train on the track using the action bricks.
- Ask:
  - What happens when the train is just traveling on the track?
  - What happens if the train is not traveling on the track?
  - What happens if the train travels across an action brick?

KEY OBJECTIVES

Students will:

- Explain the functions of hardware in Coding Express.
- Explain the functions of software in Coding Express.

STANDARDS

- CSTA 1A.CS-02 Use appropriate terminology in identifying and describing the function of common physical components of computing systems (hardware).
- CSTA 1A.CS.03 Describe basic hardware and software problems using accurate terminology.

Explore more at LEGOeducation.com

- Why does the train do different things for different action bricks? How does it know what to do? (The engine sees the different colors.)
- How does the train engine see that the colors are different? Allow students to explore the train to see if they notice the color sensor. What body part does that remind them of? Try to link this back to their senses.

Explain

- Explain how computers have both hardware and software. Examples of hardware are a tablet, a mouse, or the Coding Express train. Examples of software apps or programs we use on the computer.
- Have students identify the hardware pieces used with Coding Express (the tablet, the train, the color sensor).
- Have students identify the software (the app, the program that lets the train know how to respond to the different action brick colors).
- Have students briefly explore how the app changes the behavior of the train in response to the action bricks.
- Explain that the color sensor under the train engine reads the action brick color when it travels across it.
- The train comes with software that tells it what to do when it sees a certain color action brick. The hardware and the software work together to make the train work.

Elaborate

- Place a small piece of black construction paper or fabric over the color sensor on the bottom of the train. Ask students to predict what they think will happen.
- Place action bricks on a sequence of track to test the train. Can it read the action bricks? Why or why not?

Evaluate

Evaluate the students' skills development by observing if they can:

- Identify hardware and software elements.
- Try different strategies to deepen understanding of hardware and software.
- Ask questions about concepts related to science and technology.

LEGO® Education Coding Express

Y-Shaped Track

Explore and understand that the Y-shaped track provides options and be able to design and optimize solutions.

STEM, Creative Exploration, Social Emotional Development, Early Math and Science

K	30–45 min.	Intermed.

Prepare

- Before the lesson, make sure the LEGO® Education Coding Express sets are ready to use.
- This lesson is designed to be used with the LEGO® Education Coding Express App. Download the app at https://education.lego.com/en-us/downloads/early-learning/software and pair it with trains in the sets.
- Consider the abilities and backgrounds of all your students and decide when and how to introduce and differentiate lesson content, activities, or concepts.
- If necessary, pre-teach these related **vocabulary words:** if-then statement, conductor, signal, indicate, switch.
- If desired, download printable model Card 1 for use in Explore and Card 2 for use in Explain.
- Choose at least three spots in the room as "train stops."
- **Coding Concept:** Conditional Statement – if-then statements that modify how code is executed.

KEY OBJECTIVES

Students will:

- Understand that the Y-shaped track provides options
- Design and optimize solutions
- Be able to compare different train track shapes and their uses (i.e., sequencing, looping and conditional statements)

STANDARDS

- CSTA 1A-AP-10 Develop programs with sequences and simple loops, to express ideas or address a problem.

Extension

- CCSS.SL.K.4 Describe familiar people, places, things, and events and, with prompting and support, provide additional detail.

Engage

- Tell students that they're going to play the "colored tickets" game and identify the classroom train stops.
- Lead students in naming the stops after favorite places (e.g., playground, amusement park).
- Place different color bricks at each stop and use the same color bricks as "tickets."
- Act as the conductor, giving students tickets according to where they'd like to go.
- As you distribute tickets, introduce if-then statements (e.g., **if** you have a red ticket, **then** you go to...).

Explore more at LEGOeducation.com

- Have students walk to their destinations. Is the brick's color the same as their "ticket" color?

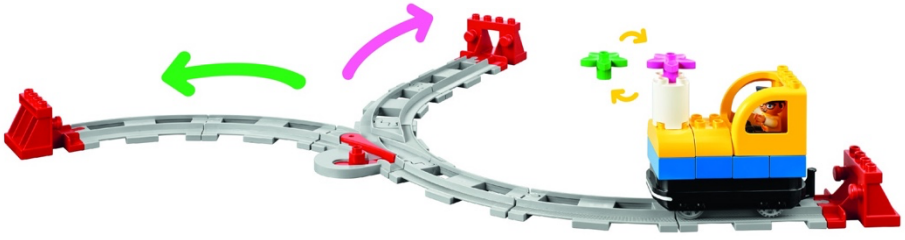
Explore

- Have students build their own colored-tickets game!
- Show them the Y-shaped track and the track with a switch.
- Ask them to build a similar Y-shaped track and at least two stops along the track (see image below and printable model card 1 for an example).
- Explain that they should use different color bricks to indicate the stops they've built; just like in the game they just played.
- Choose one student to be the conductor who passes out bricks to be used as "train tickets."
- Have each student put a LEGO® DUPLO® figure on the train, sending it to the destination matching their "ticket." Don't forget to ask each student where their figure is going.

Tip: Remind students that they have to guide the train by moving the red switch on the track. Also remind them to use action bricks to make the train stop. Use the term "if-then" after each student is given their ticket.

Explain

- Tell students that trains give signals to indicate where they want to go.
- Explain that this is like the way they used colored tickets to tell where they wanted to go.
- Talk together about how trains give signals. Ask questions like:
  - What signals can trains give? (Make a "choo choo" sound.)
  - Can trains give signals without making sounds? (e.g., by flashing their lights, giving a color signal, or by how they're decorated)
  - Which type of signal do you think is best? Why?



Elaborate

- Encourage students to use both track switches to build a three-ended or Q-shaped track.
- Talk about the logistics of running a train on this type of track.
- Ask questions like:
  - How will you give signals now that you'll have more destinations?
  - How will you help the train to go back and visit other stops? (By using the green action brick.)

Evaluate

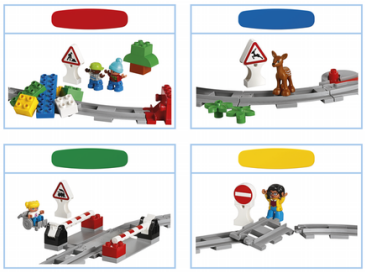
- Ask guiding questions to elicit students' thinking and their decisions while ideating, building, and programming.

Observation Checklist

- Review the learning objectives and educational standards addressed in this lesson (blue sidebar box).
- Share specific student responses and behaviors at different levels of mastery.
- Use the following checklist to observe students' progress:
  - Students can build a y-shaped track and can describe that the train has more than one path to follow.
  - Students can create a conditional statement using the track signals to indicate which conditional or option of track to take.
  - Students can describe the events of the trip, with prompting and support, as different based on the different conditions of the signals.

LEGO® Education Coding Express

Journey–Trouble on the Road



Explore and understand various traffic signs and be able to solve common problems on the road.

STEM, Creative Exploration, Social Emotional Development, Early Math and Science

K	30–45 min.	Advanced.

Prepare

- Before the lesson, make sure the LEGO® Education Coding Express sets are ready to use.
- This lesson is designed to be used with the LEGO® Education Coding Express App. Download the app at https://education.lego.com/en-us/downloads/early-learning/software and pair it with trains in the sets.
- Consider the abilities and backgrounds of all your students and decide when and how to introduce and differentiate lesson content, activities, or concepts.
- If necessary, pre-teach these related **vocabulary words:** remind, police officer, traffic sign, potential, avoid.
- If desired, download printable model Card 1 for Engage and Card 2 for Explore, and Card 3 and Card 4 for More Ideas.

KEY OBJECTIVES

Students will:

- Understand that the action bricks' behavior can be changed using the app
- Understand various traffic signs
- Be able to solve common problems on the road

STANDARDS

- CSTA 1A-AP-10 Develop programs with sequences and simple loops, to express ideas or address a problem.

Extension

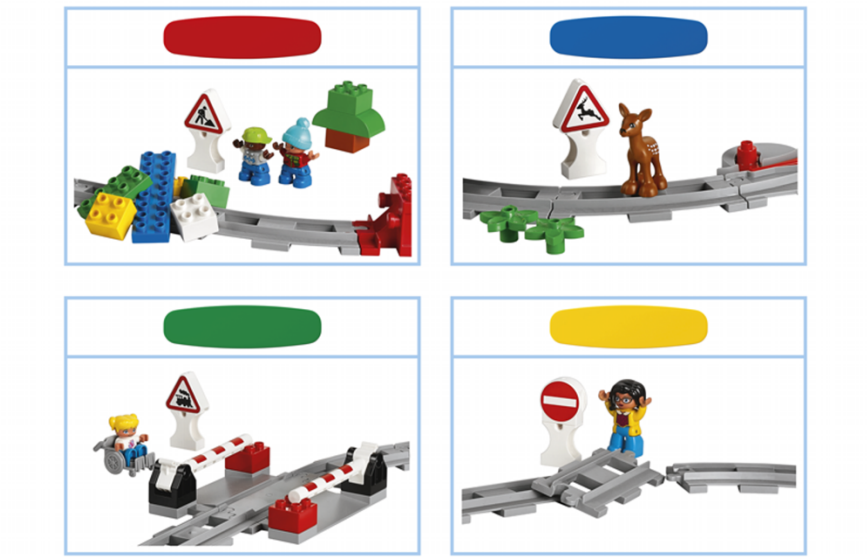
- CCSS.SL.K.5 Add drawings or other visual displays to descriptions as desired to provide additional detail

Engage

- Talk to students about traffic rules.
- Ask questions like:
  - Do you know any traffic rules? What are they?
  - Why do we need to follow traffic rules?
- Tell students that we all need to follow traffic rules.
- Explain that traffic signs are one way to remind people of the rules.
- Show the four traffic signs from the set and ask students if they can guess what they mean. Share printable model Card 1 for support.
- Tell students that they're going to play a game!
- Place the traffic signs around the classroom and ask the students to pretend they're each driving their own high-speed train.

Explore more at LEGOeducation.com

- Explain that they should slow down or stop when approaching marked areas.
- Act as a police officer controlling the flow of traffic or ask one of the students to do so.



Explore

- Have each group of students pick a building card and build the model shown.
- Have students work together to build a Y-shaped track and place their models alongside it.
- Place the action bricks in random places along the track.
- Now experiment with the app.
- Put the train on the track. Allow students to explore the different functions of each button.
- Say: Let's start the train!
- Have students take turns using the app to "drive" the train. Ask: What happens after the train passes each action brick?

Explain

- Talk to students about the problems they've seen in the app.
- Ask questions like:
  - What did you see after the train passed each stop?
  - How will you solve the problem?
  - Which traffic sign do you need in order to solve each problem?

Elaborate

- Encourage students to play and to use all the traffic signs.
- Ask if they can think of other important things to remember in order to stay safe in traffic.
- Encourage students to create their own traffic signs or models to keep them safe in traffic.
- Have them place their creations along the track and explain why they placed them where they did.

Evaluate

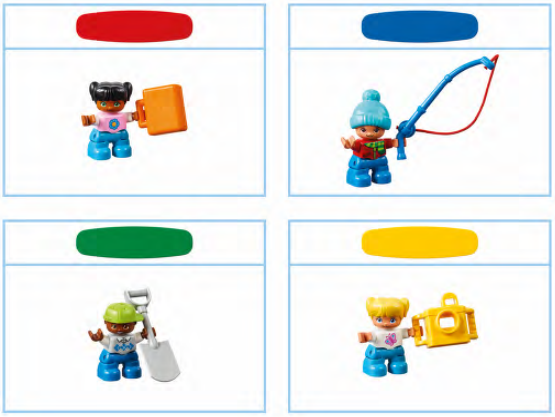
- Ask guiding questions to elicit students' thinking and their decisions while ideating, building, and programming.

Observation Checklist

- Review the learning objectives and educational standards addressed in this lesson (blue sidebar box).
- Share specific student responses and behaviors at different levels of mastery.
- Use the following checklist to observe students' progress:
  - Students can create a y-shaped track and use it to describe the journey the train is taking.
  - Students can use their models to add additional details to their descriptions of the journey.
  - Students can describe, with prompting, the repeating sequence of events on the trip.

More Ideas

- Use this lesson's format to create additional lessons for the **Passengers** and the **Four Seasons** sections of the app.
- In the Engage phase for those lessons, talk about the passengers' accessories and how the seasons should look; explore more interesting destinations with your kindergarteners.
- Use printable model Card 3 AND Card 4 (shown below) to support these additional lessons.



Card 3

Card 4

LEGO® Education Coding Express

Story Maps

Create and test a plan to tell a story using Coding Express.

STEM, Creative Exploration, and Computer Science

K	45–60 min.	Advanced

Prepare

- Before the lesson, make sure the LEGO® Education Coding Express sets are ready to use.
- This lesson is designed to be used with the LEGO® Education Coding Express App. Download the app at https://education.lego.com/en-us/downloads/early-learning/software and pair it with trains in the sets.
- Locate a story with easily recognizable characters, setting, and plot (beginning, middle, end).
- Prepare Story Map graphic organizers (see examples).
- **Vocabulary:** event, plan

Engage

- Read a story to students for inspiration.
- Have students identify the following parts of the story:
  - Characters
  - Setting
  - Beginning
  - Middle
  - End

Explore

- Model and lead students in making a plan to retell the story using Coding Express.
- Elicit students' ideas for the type of track formation, the train actions, and action bricks needed to tell the story.
- Have students test the plan by retelling the story using Coding Express train, track, and action bricks.

KEY OBJECTIVES

Students will:

- Develop a story map that describes a program's sequence of events
- Identify actions performed by the train along the track

STANDARDS

- CSTA 1A.AP.10 Develop programs with sequences and simple loops, to express ideas or address a problem
- CSTA 1A.AP.12 Develop plans that describe a program's sequence of events, goals, and expected outcomes.

Explore more at LEGOeducation.com

- Encourage students to debug the plan and make changes as needed.

Explain

- Ask: How does the train know to turn the lights on or off when traveling on the train track? (The lights turn on or off when it travels over the white action brick).
- Explain that the train traveling over the white action brick is the action, or event, that tells the train to turn the lights on or off.
- Have students identify other events for the train and what the outcome should be.

Elaborate

- Organize groups and prompt them to create a story using a Story Map graphic organizer. (See possible story map graphic organizers and an exemplar response.)
- Then have groups build and practice telling the story using their plan, debugging and making modifications as needed.
- As needed, scaffold by providing a partially completed graphic organizer that lists setting ideas and action brick colors. Prompt students to select by circling words.

Evaluate

Evaluate the students' skills development by observing if they can:

- Make connections between intended train action and action brick needed
- Use a track formation to tell the story.
- Try different strategies to debug.
- Provide a defined beginning, middle and end in their story.
- Ask questions about concepts related to science and technology.

Name: _____

Story Map

Characters
Setting
My Track Plan

Story	Train Action	Action or Action Brick
Beginning		
Middle		
End		

Name: _____

Story Map

Characters
Setting
Track and Story Builds

Story	Train Action	Action Brick

Names: Jeremy SAM Kim Shawn (EXAMPLE)

Story Map

Characters

MOMMY Jasmine

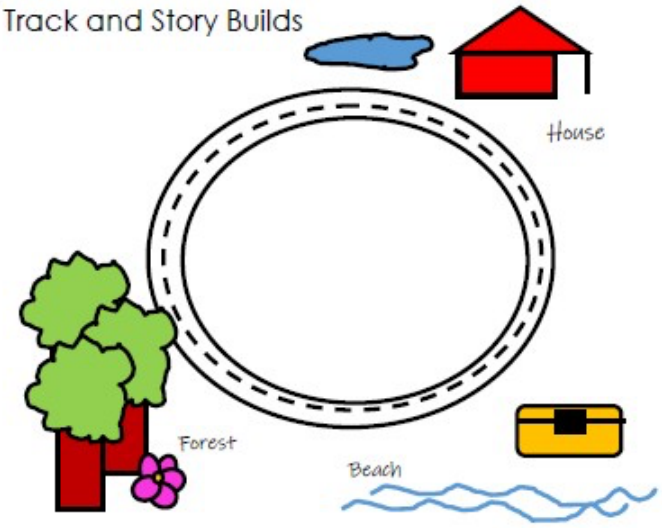
Genie Alligator

Setting

House

Beach Forest

Track and Story Builds



Story	Train Action	Action Brick
Find Genie 3 wishes	Train go	Push
Go to beach Swim Find candy in treasure box	Stop at beach	Red
Go to forest Find pink flower Forgot candy	Stop at forest Go back to beach	Red Green
Go to beach Get candy Find Alligator Go Home	Stop at beach Go back home	Red Green
Choo choo Go home Put alligator in pond Eat Candy	Train Sound Stop at house	Yellow Red