Coding for Liftoff

A Creative Coding Lesson About Sequencing

Instructional Time:
60–90 minutes

Introduction

In this lesson, students will connect the sequence of events in Blue Origin's New Shepard rocket with sequencing events in MIT's Scratch coding platform to create an animated simulation. This lesson is designed to follow the AVID STEM Connections lesson *Launching into Design Thinking* (February 2021), though the lessons may also be conducted independently of each other.

Essential Question

How can I use coding to create a simulated animation?

Lesson Objectives

Students will:

- Describe the sequence of events in the New Shepard rocket flight.
- Create an animated simulation using Scratch coding.

Materials and Resources

(Please see the AVID STEM Academy LMS for links to the resources mentioned here in a variety of formats.)

Hands-on:

- *Coding for Liftoff* Presentation
- *Coding for Liftoff* Scratch Project
- *Marketing Director Product Analysis*
- *Marketing Director Product Analysis Teacher Guide*
- *Flight Sequence Plan*
- *Flight Sequence Plan Teacher Guide*
- *Scratch Account Information for Teachers* (teacher resource)
- *Using Scratch Studios* (teacher resource)
- A computer or internet-connected device for each student or pair of students, capable of accessing the Scratch coding program

Minds-on:

- Using planning and organizational skills
- Having a growth mindset
- Taking others' perspectives
- Learning how to make a reasoned judgment after analyzing information, data, and facts

Design Thinking:

This lesson explores the indicated stages in the design thinking process:

- ☒ Empathize
- ☒ Define
- ☒ Ideate
- ☒ Prototype
- ☒ Test

Standards and Practices:

International Society for Technology in Education Standards:

- ISTE 1.5.c – Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.
- ISTE 1.5.d – Students understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.

Next Generation Science Standards:

- 5-PS2-1 – Support an argument that the gravitational force exerted by Earth on objects is directed down.
- 3-5-ETS1-2 – Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

Teacher Preparation

- Review the lesson, presentation, and materials.
- Ensure that students can log in to a Scratch account. (See the *Scratch Account Information for Teachers* document for more information.)
- Make copies of the *Flight Sequence Plan* and the *Marketing Director Product Analysis* handouts (one set per pair of students). These may also be shared digitally.
- Post the link to the *Coding for Liftoff* Scratch Project.
- Pacing Note: This lesson plan is designed to fit into two 45-minute class periods. A suggested stopping point is noted in the *Elaborate* section; however, please ensure that all student Scratch logins work before ending on the first day.

Essential Question: *How can I use coding to create a simulated animation?*

ENGAGE

Sequencing Liftoff Events

Read the *Essential Question* (Slide 2) with students.

Tell students that they will view the liftoff of Blue Origin's first human space flight, which went just above the Kármán Line (the internationally recognized line between Earth's atmosphere and space) before landing back on Earth.

Display *What Happens After Liftoff?* (Slide 3).

Ask students to share what they know about rocket liftoff after watching the one-minute video. (Some students may know that the entire rocket does not travel together throughout the trip. Certain parts are only needed for liftoff. Other parts drop into the ocean and are recycled, which some parts may burn up in the atmosphere and need to be re-created.)

Display *Challenge* (Slide 4) and read the challenge to the class. Tell students that they will be using the stages in the design thinking process to create their simulations. Use the design thinking graphic to briefly review the design thinking stages.

Resources:

Coding for Liftoff Presentation

Remote Learning Modifications:

This part of the lesson can be conducted synchronously using a virtual meeting platform.

EXPLORE

Empathize and Define

Remind students that the first phase of the design thinking process is *Empathize*, which includes understanding both the user and the need. The marketing director for the space flight used empathy to decide that an animated simulation would help customers and the public understand how the rocket works. Now we will need to use empathy to understand what the marketing director needs us to engineer, and we will define the problem by developing specific criteria that will help to meet the need.

> **Teacher Tip:** *You may want to share the description of a marketing director as included in the Career Connections section of this lesson.*

Divide students into groups of two.

Display *Empathize* (slide 5).

Distribute one copy of the *Marketing Director Product Analysis* student resource to each pair of students and read the directions together. Point out that students should think about what the marketing director would want from this project. Encourage students to think about how they can create a project that meets those needs. Students will complete the Need and Criteria columns now and the Analysis column later.

> **Teacher Tip:** *A partially completed version of this handout is on the Marketing Director Product Analysis Teacher Guide. Consult this version based on your knowledge of your students to help them empathize with their client for this project.*

Ask students what else they need to know in order to be able to start creating their animated simulations. (They need to know the stages of the rocket's flight.)

Display *Parts of a Reusable Rocket* (Slide 6) and point out the major parts of the rocket. In order to accurately portray the stages of the rocket's flight, students need to know the stages and the sequence in which they happen.

> **Teacher Tip:** *A vocabulary slide for the word "sequence" is available at the end of the Coding for Liftoff Presentation. You might point out that the word can be used as both a noun and as a verb.*

Distribute one copy of the *Flight Sequence Plan* student resource to each pair of students. Read the directions together. Students will sketch the major parts of the rocket in the column on the left. This sketch does not need to be extremely detailed, but it does need to be labeled. This will

Resources:

Coding for Liftoff Presentation

Marketing Director Product Analysis (1 per pair or digital access)

Marketing Director Product Analysis Teacher Guide

Flight Sequence Plan (1 per pair or digital access)

Flight Sequence Plan Teacher Guide

Remote Learning Modifications:

If conducting the lesson remotely, give students digital access to the handouts. You may consider having students share the document with their partners so they each can contribute to the work.

help students orient themselves to the rocket. They may begin the sketch and continue during the 2-minute video on the next slide.

Teacher Tip: *Consult the Flight Sequence Plan Teacher Guide as needed.*

Watch the video linked on *Understanding the Sequence* (Slide 7). Remind students that they will include these stages in their animated simulations.

EXPLAIN

Simulation Planning

Click the link on *Simulation Planning* (Slide 8) to visit the *Coding for Liftoff* Scratch project. Students will "Remix" this project to complete their own versions of it. Point out (or guide students to point out) the following:

- There are two sprites because they will need to travel separately after liftoff.
- Each sprite has two "When flag clicked" blocks. One block will manage the motion sequence for each sprite, while the other will manage the costume changes. This will help students keep the changes organized and clear.
- Using the "Glide to *x, y*" block will make it look like the rocket is flying to that location.
- To add a costume, click the sprite. Click the Costumes tab at the top left. Either right-click on a costume and click duplicate to change an existing costume or click the add costume button at the bottom left to draw.

Teacher Tip: *Relate the **x, y** values to locations on a map. Students are not expected to be fully familiar with the coordinate plane at this level. Demonstrate to students that you can move a sprite to a location, then pull out the blue **x, y** block with the values already entered. It may help to point out that the **x** coordinate is the horizontal (side to side) placement, while the **y** coordinate refers to the vertical (up and down) placement.*

Instruct students to complete the right-hand columns on the *Flight Sequence Plan*. Some suggestions are included in the teacher copy on the second page of the document. Point out to students that they are working in the *Ideate* phase of design thinking as they come up with ways to meet the criteria that will solve the problem. Remind them to revisit the criteria periodically to ensure they are creating a product that will empathize with their users' needs.

Resources:

Coding for Liftoff Presentation

Coding for Liftoff Scratch Project

Flight Sequence Plan

Remote Learning Modifications:

If conducting this lesson remotely, share your screen to orient students to various Scratch features they will need for this project.

ELABORATE

Simulation Creation

Instruct students to log in on the *Coding for Liftoff* Scratch Project.

> **Teacher Tip:** *This is a good place to stop for the day. Before ending the lesson, make sure all students can log in to Scratch.*

Display *Simulation Prototyping* (Slide 9) and allow students to click *Remix* and begin creating their simulations.

Allow students to continue working on their projects. Circulate to help them as needed.

Encourage early finishers to add extra features to their simulations. Some examples include the following:

- Create sound effects that play during liftoff.
- Create visual or audio labels for each flight stage.
- Make the backdrop change to a space backdrop when the capsule is at its highest point, then change back to the desert backdrop as the capsule descends.
- Create a title screen for the simulation.

> **Teacher Tip:** *If you notice that some students are especially skilled at using Scratch, designate these students as "experts" who can assist classmates as needed.*

Resources:

Coding for Liftoff Presentation

Coding for Liftoff Scratch Project

Flight Sequence Plan

Remote Learning Modifications:

Scratch does not currently support students working on a single project simultaneously. Allow students to create their projects individually but provide them with the ability to ask for help as needed via a virtual meeting platform.

EVALUATE

Marketing Director Approval

Display *User Testing* (Slide 10).

Remind students of their empathy work at the beginning of the lesson when they thought about what the marketing director needs in this simulation.

Instruct students to trade computers with a partner or share a link using the instructions in the Remote Learning Modifications and to complete the *Analysis* column of the *Marketing Director Product Analysis* student resource.

Allow students to make improvements to their work, as time allows.

Resources:

Marketing Director Product Analysis

Coding for Liftoff Scratch Project

Coding for Liftoff Presentation

Remote Learning Modifications:

To share their projects, students can share their screens to demonstrate their animations.

Close the lesson using the *Zip Around* strategy (Slide 11) by asking students to take turns quickly sharing one improvement they would like to make to their Scratch projects.

Alternatively, students can share project by clicking "Share" at the top of the screen, then going to the project page. Near the bottom right is a "Copy Link" button that students can use to share their individual project links with you or with their classmates. Consider setting up a "studio" to make sharing easy. For more information, the Using Scratch Studios document is linked in the STEM Connections LMS Matrix.

Vocabulary

- **Appearance:** The way that someone or something looks
- **Booster:** A shorter-burning rocket that helps a vehicle launch into space
- **Kármán Line:** The internationally recognized boundary between Earth's atmosphere and outer space
- **Descend:** To move or fall downward
- **Prototype:** (n.) An early sample or model of a product to test a concept or process; (v.) To create a prototype
- **Sequence:** (n.) A particular order in which related events, movements, or things follow each other; (v.) To arrange in a particular order
- **Simulation:** The production of a model of a situation or process, including a computer model of something, especially for the purpose of study
- **Stabilize:** To hold or make steady

Career Connections

- **Aerospace Engineers** design aircraft, spacecraft, satellites, and missiles.
- **Marketing Directors** oversee the promotion and advertising of a company's products and brand.
- **Simulation Engineers** work on complex engineering projects to create simulations for testing the performance of proposed solutions.

Please visit the link to the Occupational Handbook of the Bureau of Labor Statistics for specific career information. https://www.bls.gov/ooh/

Extensions and Modifications

Lesson Extensions:

- **Animated Plot Diagram:** Have students create an animated plot diagram of a familiar story or book. (A picture book works especially well for this activity.) After completing a plot diagram of the story, allow students to design sprites, a background, and an animation that functions as a digital retelling of the story. A sample plot diagram form can be found at Read Write Think.
- **Real World Application:** Have students create a postcard to send to space. The postcard would be taking the ride of a lifetime and following the liftoff sequence that was coded onboard a New Shepard Rocket through the Blue Origin "Send a Postcard to Space" Program: Blue Origin Club for the Future | Postcards to Space.

Resources:

Read Write Think Plot Diagram

Blue Origin Club for the Future – Postcards to Space