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Light Show Lab: Wire the Control Box

Grades 6-8 · 45 minutes

Computer science · Technology



Slides, rubric and answer key | Print and go | No student accounts | Chromebook friendly

What's included

- A one-page overview: objectives, essential question, vocabulary, standards and assessment
- A 45-minute lesson sequence: warm-up, direct instruction, guided practice, independent practice, closure
- Slides for the board: a PowerPoint file that also opens in Google Slides
- A student worksheet with a QR code and a wiring table
- A 3-question exit ticket, two to a page, with an answer key
- A rubric: 3 criteria, 4 levels, scored out of 12
- Differentiation for English learners, students with IEPs or 504 plans, and students who need more support or more challenge
- Cross-curricular extensions, and notes for teaching it in grades 4 and 5 and in high school
- Standards: CSTA 2017

Light Show Lab: Wire the Control Box

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The lights are hung and the house is dark, because nothing is plugged into the controller. Students plug each run into a port by tapping it on the house, watch the roofline come alive on its own, and wire the rest until the box would run the show. Then they break it on purpose: feed the roofline from its other end and the chorus chase runs backwards; swap to a 4-port board and chain runs together, and the tree's first pixel becomes number 263 on its port. A port has time for about 1,024 pixels, and the ones past that stay dark.

At a glance

ESSENTIAL QUESTION

What has to be connected, and in what order, for a program to reach a light?

OBJECTIVES

Students will be able to:

- describe the job of each part of a light show: the controller, a port, a pixel and the power supply
- explain that a pixel has no number of its own, and that its place in the chain is its address
- predict what a show will do when a run is unplugged, fed from its other end, or chained past what a port can reach
- find an unplugged or miswired run by testing the ports one at a time

VOCABULARY

Controller, Port, Pixel, Address, Power supply

STANDARDS

1B-CS-01, 1B-CS-02, 2-CS-03

TIME AND MATERIALS

45 minutes, grades 6-8.

- One computer or Chromebook per student
- A projector
- The worksheet and exit ticket, one copy each per student
- The rubric, one copy per student if you grade the work

PREP

Make copies of the worksheet and exit ticket. Before class, open mytekdev.com/try/lightshowlab?lesson=wire-the-control-box&ref=tpt-lightshowlab-3 once on a student computer: it opens on a dark house, and checks that your school's filter allows the app. Follow the short guide yourself, about five minutes, then press 4 ports and chain two runs onto one port.

ASSESSMENT

- Formative: the questions under What to look for, asked while students work, and the exit ticket (answer key included).
- Summative: the worksheet, scored with the rubric.

TECHNOLOGY AND PRIVACY

Runs in any browser, Chromebooks included, with nothing to install. Students need no account and no email: the link works signed out, and nothing they do is stored on our server unless they choose to save. The music is played by the page, so headphones help, and the Sound button turns it off.

Lesson sequence

MINUTES	STAGE	WHAT YOU DO	WHAT STUDENTS DO
0 to 5	**Warm-up** Hook	Show the title, essential question and Today I can slides (about 1 minute). Then the warm-up: the lights are hung and the house is dark. What two things could be missing? Write power and data on the board.	Answer the warm-up on the worksheet.
5 to 12	**Direct instruction (I do)** Model it	Project the app with the starter open and open Box. Read the status box: not plugged in, six runs. With port 1 picked, tap the roofline on the house and read the message: the data goes in at the end you tapped. Play a few bars: only the roofline runs. Show Data out of a port, down a chain, then A pixel has no number of its own. **It's working when:** Play the show with one run plugged in. A dark house with one live roofline makes the point that hanging lights and connecting them are different jobs.	Watch, and fill in the vocabulary on the worksheet.
12 to 22	**Guided practice (We do)** Plug it in	Students open the link or scan the QR code. A short guide walks them through: plug in the roofline, play, give every run a port, and press Test the ports. Check that every status box says the box would run the show. **Watch for:** Students who tap a second run without picking a new port. Both runs land on port 1 as one chain. It works, and it is the next part of the lesson: ask them what the second run's first pixel number is.	Wire the house and fill in the wiring table: which run is on which port, and how many pixels.
22 to 38	**Independent practice (You do)** Break it on purpose	Three changes, each predicted on the worksheet first: feed the roofline from its other end; switch to a 4-port board and chain the tree after the porch; chain the bushes after the tree. Walk the room with the What to look for questions. **If they ask:** "The tree was pixels 1 to 600 on its own port. What are its numbers now, and did the tree itself change?" The address	Predict, change, play, and record what the house did.
38 to 45	**Closure** Showcase and exit ticket	Show the Showcase slide. Two students say what they would check first for one dark run. Draw out an order: is it plugged in, which port, which end. Hand out the exit ticket.	Answer the exit ticket.

Before you teach: a ten-minute walkthrough

Open mytekdev.com/try/lightshowlab?lesson=wire-the-control-box&ref=tpt-lightshowlab-3. A short guide opens over the app. The house is dark: its lights are hung and none is plugged into the controller. The Box tab is set to "I will

wire it".

1. **Plug one in.** Open `Box`. The status box reads "Not plugged in: Roofline, Upstairs, Downstairs, Porch, Tree, Bushes." Port 1 is picked. Tap the roofline on the house and a wire is drawn to it: "Roofline is on port 1. The data goes in at the end you tapped, so a chase starts there."
2. **Wire the rest.** Click a port, then tap a run on the house, or click its chip under Not plugged in. With all six on their own ports the status reads "Every run is plugged in, every port can reach its lights, and the power fits. This box would run the show." The ports hold 61, 160, 105, 262, 600 and 300 pixels, and the power line reads 268 of 278 watts planned.
3. **Test the ports.** `Test the ports` lights each port in turn. `Wire it for me` plugs everything in, and `Unplug it all` empties the board.
4. **The other end.** Click the `Roofline 61` chip and press `Feed the other end`. The chorus, from bar 19, has a chase on the roofline: it now runs the opposite way.
5. **Chains.** Press `4 ports`: "2 runs have nowhere to plug in now." Click `Port 4`, then the `Tree 600` chip: port 4 reads 862 of 1,024, and the tree is pixels 263 to 862. Add `Bushes 300` to the same port: 1,162 of 1,024, the status box warns, and the bushes past pixel 1,024 stay dark.

> The dark pixels past 1,024 are a stand-in. The app says so: a real controller would slow down or refuse the setup. The limit is about time, how many pixels a port can send to before the next frame is due.

Background for the teacher

A real computer-run light show has three parts. The show itself is a file made in sequencing software: for every moment of the song, a color for every bulb. A controller, a small computer in a weatherproof box, reads that file and sends the colors out of its ports. And the lights are pixels: each bulb has a tiny chip that can be told its own color.

The data travels down each chain in one direction. The first pixel keeps the first color that arrives and passes everything else along; the second keeps the next; and so on. A pixel has no number stored in it. Its address is only its place in line, which is why feeding a run from its other end reverses a chase, and why chaining a run after another renumbers it.

Power is separate. A power supply turns wall current into 12 volts for the pixels, and it has a limit in watts. In this lesson the power only has to fit. The Real level of the app adds voltage loss along a chain, fuses and injection wires, and the Fix-it houses lesson uses them.

What the app simplifies: students tap to plug in, where a real box has screw terminals and waterproof connectors; several power supplies are added up as one; and the wall side of a real supply is house current, which only an adult wires. The safety note at the bottom of the Box tab says so.

What to look for

Ask these while students work. A student who has understood the lesson can answer them without help:

- What comes out of a port: power, data, or both?
- Why did the chase on the roofline turn around?
- The tree is chained after the porch. What is its first pixel number, and why?
- Some of the bushes are dark and nothing is unplugged. What is wrong?
- One run is dark. How would you find out which port it is on?

> The third question is the test for addresses: 263, because the porch's 262 pixels each took one color first. A student who adds 262 and 1 has the idea.

Cross-curricular extensions

- Math: six runs hold 61, 160, 105, 262, 600 and 300 pixels. Which sets of runs can share one port without passing 1,024?
- Science: find out why holiday pixels run on 5 or 12 volts and not on wall current.
- Writing: write the steps for wiring this house so that someone who has never seen the app could do it.
- Careers: look up what a lighting technician does at a concert or a theater.

Vocabulary

Controller	A small computer that sends every bulb its color, many times a second.
Port	One output on the controller. Each port feeds one chain of lights.
Pixel	A bulb that can be told its own color. It keeps the first color that reaches it and passes the rest along.
Address	Where a pixel sits in its chain: the first one after the port is pixel 1.
Power supply	The box that turns wall power into the low voltage the pixels run on.

Differentiation

ENGLISH LEARNERS

- Keep the vocabulary slide up, and point at the house on the board as you say each word: the lights carry the meaning.
- Label a printed screenshot of the house with the five vocabulary words before students start.
- Accept the predictions as arrows drawn on the roofline for the direction of the chase.

STUDENTS WITH IEPS OR 504 PLANS

- Pair students, one tapping the house and one reading the status box aloud.
- Turn on Big screen, or zoom the browser to 150%.
- Allow the wiring table alone where the IEP allows a modified assignment; Wire it for me repairs any mistake in one press.

STUDENTS WHO NEED MORE SUPPORT

- A sentence starter: "The roofline chase ran backwards because the data went in at the ___."
- A check-in after the guide: every status box reads would run the show before anyone breaks it.
- Do the first break together on the board, then students repeat it.

STUDENTS READY FOR MORE

- Press Add a power supply, then take it away. Tap the power bar and read the sum. Why is the plan 278 watts when a supply gives more?
- On a 4-port board, find a way to chain all six runs so that no port passes 1,024 pixels.
- Open How it works and read The control box. Which part of a real box does this app leave out?

Adapting for other grades

Younger students: In grades 4 and 5, stop after the guide and the first break: students wire the house, test the ports, and feed the roofline from its other end. Leave out the 4-port board. Score the first two rubric rows, total 8, and 6 meets the objectives.

Older students: In high school, add the numbers behind an address: each pixel takes three channels, red, green and blue, so the roofline's 61 pixels use channels 1 to 183 and the upstairs windows start at channel 184. The Real level of the Box shows this address table, counted from port 1 (the tree starts at channel 1,765); the Fix-it houses lesson uses it.

Student worksheet

Name: _____ Date: _____

Open the app: scan the QR code, or go to mytekdev.com/try/lightshowlab?lesson=wire-the-control-box

Essential question: What has to be connected, and in what order, for a program to reach a light?

Warm-up: Every light on this house is hung, and the house is dark. Two things that could be missing: _____ and _____

1. **Vocabulary.** Controller, port, pixel, address, power supply: write each in your own words.

2. **The wiring table.** Port 1: _____, _____ pixels. Port 2: _____, _____ pixels. Port 3: _____, _____ pixels. Port 4: _____, _____ pixels. Port 5: _____, _____ pixels. Port 6: _____, _____ pixels.

3. **Break 1: the other end.** I predict the roofline chase will _____. It did: _____.

4. **Break 2: a chain.** On a 4-port board, with the tree chained after the porch, I predict the tree's first pixel is number _____. The app says pixels _____ to _____.

5. **Break 3: too long.** With the bushes chained on too, port 4 has _____ pixels. I predict _____. It did: _____.

1. A pixel has no number written inside it. So how does the controller light just one bulb in the middle of the tree?

2. One run of lights is dark and the rest are fine. What do you check, in what order?

Exit ticket

Name: _____

1. What does a port on the controller send down the chain? (A) the color for every pixel on it (B) only electricity (C) the song

2. The porch has 262 pixels. The tree is chained after it on the same port. The tree's first pixel is number: (A) 1 (B) 262 (C) 263

3. A chase runs the wrong way along the roof. Write one sentence about what is wrong and how to fix it.

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Exit ticket

Name: _____

1. What does a port on the controller send down the chain? (A) the color for every pixel on it (B) only electricity (C) the song

2. The porch has 262 pixels. The tree is chained after it on the same port. The tree's first pixel is number: (A) 1 (B) 262 (C) 263

3. A chase runs the wrong way along the roof. Write one sentence about what is wrong and how to fix it.

Answer key: exit ticket

QUESTION	ANSWER	WHY
1	A	The port carries data: a color for each pixel, in order. Power comes from the power supply.
2	C	The porch's 262 pixels each keep one color first, so the next color belongs to pixel 263.
3	Open answer	A full answer says the data goes in at the wrong end of the run, and feeding the other end, or reversing the chase in the show, fixes it.

Rubric

Score each row from 1 to 4.

Name: _____

CRITERIA	4 EXCEEDS	3 MEETS	2 APPROACHING	1 BEGINNING
The system	Names what the controller, a port, a pixel and the power supply each do, and separates data from power.	Names what the controller, a port and a pixel each do.	Names the parts without saying what they do.	No parts named.
Addresses	Explains that a pixel's address is its place in the chain, and works out the tree's new numbers after chaining.	Says the tree's pixel numbers change when it is chained after the porch.	Records the numbers without saying why they changed.	No addresses recorded.
Predict and test	Predicts all three breaks before making them, tests each, and explains any prediction that was wrong.	Predicts and tests two of the breaks.	Tests the breaks without predicting.	No breaks tested.

Total: ____ / 12. A score of 9 or more meets the objectives.

Standards

The lesson is built for the computing systems standards: the box as a system of parts, hardware and software working together, and finding a fault one part at a time. The CSTA level 1B standards are written for grades 3 to 5 and are the closest statements of what this lesson teaches; 2-CS-03 is the grades 6 to 8 one.

FRAMEWORK	CODE	GRADES	STANDARD	HOW THE LESSON MEETS IT
CSTA 2017	**1B-CS-01**	3-5	Describe how internal and external parts of computing devices function to form a system.	Students describe what the controller, a port, a pixel and the power supply each do, and how they form one system.
CSTA 2017	**1B-CS-02**	3-5	Model how computer hardware and software work together as a system to accomplish tasks.	Students model the chain from the show, software, to the controller and the pixels, hardware, by wiring it and watching what each connection changes.
CSTA 2017	**2-CS-03**	6-8	Systematically identify and fix problems with computing devices and their components.	Students find an unplugged or miswired run by testing the ports one at a time, and say what they would check first, second and third.

Checked November 2026 against: CSTA K-12 Computer Science Standards, Revised 2017.

Optional: save student work in a free class

The whole lesson runs at the link on the worksheet, with no accounts and no sign-up.

To keep students' work, and see it all in one place, make a free class. It takes about ten minutes, once, and covers every lesson in this series: mytekdev.com/tools/class-setup

Students in a class open mytekdev.com/tools/light-show-lab/lessons/wire-the-control-box/start instead of the worksheet link. Each one gets their own copy of the starter, and the same link reopens it next time.

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