Family edition

Light Show Lab: Wire the Control Box

Ages 11-14 · about 45 minutes, in one sitting

Your child wires the control box of a holiday light show in Light Show Lab. The lights are already hung, and nothing works until each string is plugged into the small computer that runs the show.

What you need

- A computer or Chromebook with a current browser.
- The link: mytekdev.com/try/lightshowlab?lesson=wire-the-control-box&ref=fam-lightshowlab-3. No account, no email and nothing to install.

Before you start: try it once yourself

Open mytekdev.com/try/lightshowlab?lesson=wire-the-control-box&ref=fam-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.

The ideas, in plain words

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: children 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.

Do it together

1. Open mytekdev.com/try/lightshowlab?lesson=wire-the-control-box&ref=fam-lightshowlab-3 together. The house is dark. Ask: the lights are up, so what two things could be missing? Then open `Box`.

   > **You'll know it worked when:** The status box lists six runs that are not plugged in.

2. Tap the roofline lights on the house, near their left end, then press `Play the show`.

   > **You'll know it worked when:** Only the roofline runs. The rest of the house stays dark.

3. Click `Port 2` and tap the upstairs windows. Give every run its own port.

   > **If you get stuck:** `Wire it for me` plugs everything in, and `Unplug it all` starts over.
   >
   > **You'll know it worked when:** The status box says the box would run the show.

4. Click the `Roofline 61` chip, press `Feed the other end`, and play from bar 19.

   > **You'll know it worked when:** The chase along the roof runs the other way.

5. Press `4 ports`. Two runs have nowhere to plug in. Click `Port 4`, then the `Tree 600` chip under Not plugged in.

> **You'll know it worked when:** Port 4 reads 862 of 1,024, and the tree is now pixels 263 to 862.

Talk about it

Ask these while you work together. A child who has understood it 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 child who adds 262 and 1 has the idea.

For younger and older kids

Younger: For a younger child, wire the house and press `Test the ports`, and stop there.

Older: For an older child, press `Real` and read the Addresses table: every pixel takes three numbers, for red, green and blue.

Keep going

- 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?

Bring it into other subjects

- 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.

For your records

Ready to copy into an hour log, a portfolio or a transcript.

LESSON	Light Show Lab: Wire the Control Box
SUBJECTS	Computer science, Technology
TIME	45 minutes
WHAT WE DID	Wired a simulated light show controller, explained how data and power reach each light, and predicted and tested the effect of three wiring changes.
SKILLS PRACTICED	Computing systems; Addresses; Predicting and testing

Activity sheet (optional)

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?

_____

_____

Quick check

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.

Answers

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.

If your state or umbrella school asks, this lesson covers CSTA 2017 1B-CS-01, CSTA 2017 1B-CS-02, CSTA 2017 2-CS-03.

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The app this lesson uses is free and runs in the browser, with nothing to install and no account needed. It is at mytekdev.com.

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