Family edition

Light Show Lab: Fix-It Houses

Ages 12-15 · about 45 minutes, in one sitting

Your child fixes broken holiday light shows in Light Show Lab. Each house has one thing wrong in its control box, and the job is to work out what, starting from what can be seen on the house.

What you need

- A computer or Chromebook with a current browser.
- The link: mytekdev.com/try/lightshowlab?lesson=fix-it-houses&ref=fam-lightshowlab-4. No account, no email and nothing to install.

Before you start: try it once yourself

Open mytekdev.com/try/lightshowlab?lesson=fix-it-houses&ref=fam-lightshowlab-4. A short guide opens over the app. The house works, and the Box tab is at the Real level, which shows amps on every port, a power meter, an Addresses table and, at the bottom, six fix-it houses. Each one replaces the house with the first house and one fault. `Back to my own house` returns to the working box.

FIX-IT HOUSE	WHAT CHILDREN SEE	THE CAUSE	A FIX
The chase runs the wrong way	In the chorus, from bar 19, the roofline chase runs toward the peak	The roofline is fed from its far end	Click Roofline 61, then Feed the other end
The tree turns orange	From bar 19, part of the tree is orange or pink when it should be white	One injection wire is not enough: the voltage sags in the middle of 600 pixels	Click Tree 600, then Add an injection wire
Red and green are swapped	The porch posts are green and white	The controller sends GRB to pixels that read RGB	Press RGB
A port goes dark	The porch lights go dark at bar 3 and stay dark	Port 4 is asked for 6.0 amps and its fuse is 5; the brightness is 60 percent	Click Porch 262, then Add an injection wire; or turn the brightness down to 30
The whole house is dim	Most of the show is dim	The show wants 526 watts at its brightest and one supply gives 348; the brightness is 75 percent	Add a power supply; or turn the brightness down to 30
Most of the bushes stay dark	The far two thirds of the bushes never light	Port 5 has 900 pixels and has time for about 700 at 40 frames a second	Press 20; or unplug Bushes 300 and plug it into port 6

1. **Read a bulb.** At the Real level, tap any bulb on the house. A line under the Addresses table gives its port, its pixel number, its channels and the three numbers the controller is sending it, and says why the bulb shows something else if it does.

2. **The status box.** It lists everything wrong with the box, in words, with numbers: which port, which bar, how many amps or volts. A house reads "Fixed" only when nothing is left on that list.

> The orange tree and the dim house are faint on some screens. The status box says what the house shows, so children can work from it. The volts and amps come from a simple model with typical numbers; How it works in the app says what it leaves out.

The ideas, in plain words

Troubleshooting is a method, not a talent. Start from the symptom, what can be seen. Check in a fixed order so that nothing is skipped, and write down the checks that find nothing, because each one rules something out. For a light show the usual order is power, then data, then settings.

Power. Every pixel draws current, and more when it is brighter. Each port has a 5 amp fuse that cuts off when the show asks for more. A long chain also loses voltage along its wire, so the far pixels get less than they need: blue and green fade first and white turns pink, then orange. An injection wire brings power in further along the chain, which fixes both. A power supply has a limit in watts, and an overloaded one shuts off and tries again.

Data. The controller sends a color for every pixel down the chain, a fixed number of times a second. A run fed from its far end plays its chase backwards. A port has only so much time before the next frame: about 700 pixels at 40 frames a second, about 1,024 at 20.

Settings. A color is three numbers, each 0 to 255, for red, green and blue. Pixels are made that expect them in different orders. If the controller sends green first to a pixel that expects red first, every red becomes green. Nothing is broken: two parts disagree about what the numbers mean, which is a common kind of fault in every computing system.

Do it together

1. Open mytekdev.com/try/lightshowlab?lesson=fix-it-houses&ref=fam-lightshowlab-4 together and open `Box`. Scroll to the bottom and press `Red and green are swapped`.

   > **You'll know it worked when:** The porch posts are green and white.

2. Ask what is wrong, in plain words, before any guess at why. Then tap a green bulb and read the line under the Addresses table.

   > **You'll know it worked when:** It says the controller sends the numbers as green, red, blue.

3. Press `RGB`.

   > **You'll know it worked when:** The box says Fixed, and the posts are red and white.

4. Press `A port goes dark` and play the show from the start. Then stop and read the status box.

   > **If you get stuck:** The status box names the port, the bar and the amps, and suggests three ways out.
   >
   > **You'll know it worked when:** Port 4 asks for 6.0 amps and its fuse is 5.

5. Click the `Porch 262` chip and press `Add an injection wire`.

   > **You'll know it worked when:** The box says Fixed.

6. Pick two more houses. For each, write what you saw, what you checked, and what fixed it.

   > **You'll know it worked when:** Your child can say what they checked that turned out to be fine.

Talk about it

Ask these while you work together. A child who has understood it can answer them without help:

- What is the symptom, in one sentence, with no guess in it?
- What did you check first? What did that rule out?
- The controller sends red 255, green 0, blue 0 and the bulb is green. Is the controller wrong?
- Why does adding an injection wire stop a fuse from tripping?
- Two fixes work for this house. Which would you pick, and what does it cost you?

> The third question is the test for the idea of encoding: the numbers are right and the order is wrong, so neither part is broken. They disagree.

For younger and older kids

Younger: For a younger child, do the swapped colors and `The chase runs the wrong way`, which are one click each to fix.

Older: For an older child, fix `Most of the bushes stay dark` two different ways and compare them.

Keep going

- Fix A port goes dark a second way. Which fix would you choose for a real house, and why?

- Most of the bushes stay dark has two different fixes. Find both and say what each one costs you.
- Go back to your own house, break the box in a way no fix-it house does, and write the symptom for a friend to diagnose.

Bring it into other subjects

- Math: a port has a 5 amp fuse at 12 volts. Volts times amps is watts. How many watts can one port deliver?
- Science: find out why a thin wire gets warm when too much current runs through it, and what a fuse does about it.
- Writing: turn one row of your fault log into a help page: "If you see this, check these things in this order."
- Careers: ask someone who fixes cars, computers or networks what they check first, and why.

For your records

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

LESSON	Light Show Lab: Fix-It Houses
SUBJECTS	Computer science, Engineering
TIME	45 minutes
WHAT WE DID	Diagnosed and fixed faults in a simulated lighting controller, working from symptom to cause in a fixed order and keeping a written log.
SKILLS PRACTICED	Troubleshooting; Symptoms and causes; Color as three numbers

Activity sheet (optional)

Name: _____ Date: _____

Open the app: scan the QR code, or go to mytekdev.com/try/lightshowlab?lesson=fix-it-houses

Essential question: When something is wrong with a system, how do you find the one thing that is wrong?

Warm-up: Half the lights on a house go dark in the middle of the show. Three things that could be wrong: _____

1. **Vocabulary.** Symptom, cause, fuse, amp, RGB: write each in your own words.

2. **The order.** I check _____ first, then _____, then _____.
3. **Fault log, house 1.** House: Red and green are swapped. Symptom: _____ What I checked: _____ Cause: _____ Fix: _____
4. **Fault log, house 2.** House: A port goes dark. Symptom: _____ Port _____, bar _____, _____ amps asked of a _____ amp fuse. Cause: _____ Fix: _____
5. **Fault log, houses 3 and 4.** For each: House, symptom, what I checked, cause, fix.

1. Name one thing you checked that turned out to be fine. What did that tell you?

2. The controller sent the right numbers and the bulb still showed the wrong color. How can both be true?

Quick check

Name: _____

1. Part of a house goes dark during the show. What do you do first? (A) add a power supply (B) write down exactly what you see, and when (C) start over

2. A controller sends red 255, green 0, blue 0. The bulb shows bright green. The most likely cause: (A) a tripped fuse (B) the color order is set wrong (C) the bulb is unplugged

3. A port's fuse trips when the show gets bright. Write one sentence naming a fix and why it works.

Answers

QUESTION	ANSWER	WHY
1	B	The symptom comes first. A fix made before the fault is understood can hide it or add a second one.
2	B	The bulb is lit, so it has power and data. It is reading the first number as green: the order is wrong.
3	Open answer	A full answer names a fix that lowers the current through the port: an injection wire shares the load, lower brightness draws less, fewer pixels on the port draw less.

If your state or umbrella school asks, this lesson covers CSTA 2017 2-CS-03, CSTA 2017 1B-CS-03, CSTA 2017 2-DA-07.

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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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