# Lesson 2: Getting Started

**Setting up Your Board**

**Testing Your Board**

**Input and Output Devices**

# Getting Started

This chapter is all about how to get started with no-code programming and using your board.

Beginning with 'Setting up your Board', you will learn how to set up your computer, including how to download the XOD IDE, USB drivers and Biomaker tutorial files.

This is followed by two tasks: 'Testing your Board' and 'Input and Output Devices'. In Task 1 you will use the XOD IDE to test your connection and programme the simple LED on your board. In Task 2 you will learn how to build a simple device using the button and buzzer modules on your board, as well as expanding your knowledge of how to use XOD.
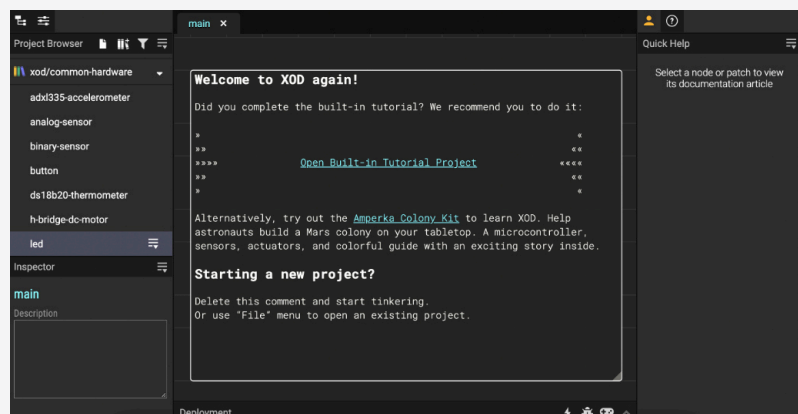


*The XOD welcome screen*

**OBJECTIVES**

By the end of this chapter you should be able to:

- Prepare your Biomaker starter kit by downloading the relevant software and drivers, plugging in your board, and opening the XOD IDE.
- Name the different sections of the XOD IDE and understand what they are used for.
- Apply your knowledge of the XOD IDE to perform the following simple tasks: add a node, change pin settings, connect nodes, add a library.
- Use the XOD IDE to upload programmes to your board.
- Use the XOD IDE to clear programmes from your board.
- Use three of the inbuilt components on the Grove board: the LED, the buzzer and the button.
- Understand how to troubleshoot your programme and find additional help.
- Understand how input and output devices can be used together to build simple devices.

# Setting up your Board

## Downloads

**XOD**

To download the free XOD software, simply visit **www.xod.io** and download the desktop IDE from the XOD homepage. You will need to download the correct IDE for your operating system  (Windows, MacOS, Linux etc.).

Note that a browser-based IDE is also available, but does not support hardware, so is not suitable for use with this guide.

**USB DRIVER**

For your computer to communicate with your Arduino board it will need to have the correct driver installed, in this case, a CP210 driver. Most operating systems will already have the correct drivers installed, including: Windows 7 and 10, Mac OSX v10.10.5 (Yosemite) to v10.15.5 (Catalina), Linux and Ubuntu v18.04.2, 64-bit.

If you are using one of the above systems we suggest ignoring this step and continuing with the guide.

If you are using a different operating system, or are having trouble connecting with your board, you may need to download a CP210 driver. Downloads for most common operating systems are available from Silabs at: **www.silabs.com/products/development-tools/software/usb-to-uart-bridge-vcp-drivers**.

**TUTORIALS**

To accompany this guide, the Biomaker team has created a  XOD tutorial file. This file will allow you to work through the tasks in this guide within the XOD environment.

You can choose to work through the tasks by using the step-by-step instructions in this book, by using the XOD tutorial file, or by using a combination of both.

If you chose to use the XOD tutorial file, we advise that you take the time to read though the introduction and information at the start of each chapter in this guide, otherwise you may miss out on useful information.

You can download the XOD tutorial file on the Biomaker website at: **www.biomaker.org/nocode-programming-for-biology-handbook**.

# Testing your Board

## Task 1: Requirements

- Computer running MacOS, Windows or Linux (XOD software and USB driver installed)
- Grove Beginner Kit for Arduino (LED and Button modules)
- USB-A to micro USB cable

Now that you've downloaded the software you're all set and ready to get stuck in!

This task will walk you through how to connect your board to the computer and upload your first programme using XOD.

We'll be using the LED light in the top left corner of the board to test our connection.

You may notice that when you first plug in the board the OLED screen in the middle-left turns on. This is part of the inbuilt demo mode on the board. You can learn more about this in the Grove User Manual.
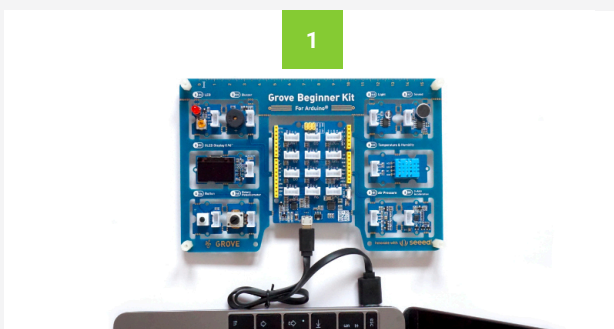


**PLUG IN YOUR BOARD**

Use the USB cable provided to plug your board into the computer. You can find this cable in the right-hand compartment of the Grove box. Plug the micro USB end into the socket at the bottom of the central section of the board, and the standard USB (USB-A) end into your computer.
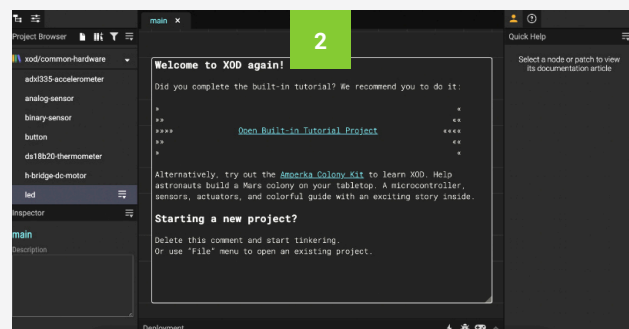


**OPEN THE XOD IDE**

Open up the XOD software on your computer.

If you are using the tutorial file provided, open this file in XOD. You can follow the instructions in patches *tuto101-tuto114* to complete this task.
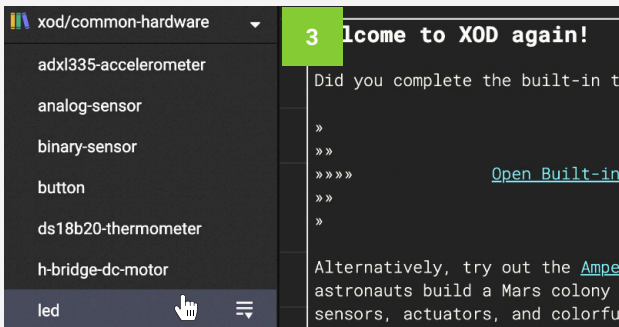
**ADD AN LED NODE**

Using the Project Browser on the top left, find the *xod/common-hardware* library, click the dropdown menu and find the node called "*led*". Click on this node and drag it into the patch. This is one of several ways to add a new node. See the Adding Nodes to your Patch box for more information on alternative methods.
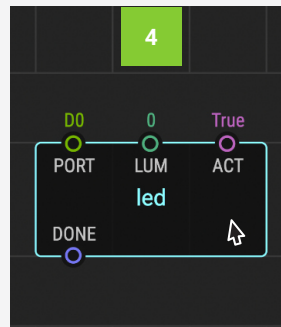


**SELECT THE NODE**

Click on the *led* node. The outer edge will turn blue and more information will appear in the Inspector pane on the bottom left.

# Adding Nodes to your Patch

There are several different ways to add a node to your XOD patch, and which one you use is completely up to you!

1. **DRAG FROM LIBRARIES**
   As described above. If you know the library the node is in, you can find the library in the Project Browser, click the dropdown menu, click on the node, drag it into the patch and release.

2. **DOUBLE CLICK ON THE PATCH**
   If you know the name of the node you want, or want to search for a node you can use the search bar. Double click anywhere in your patch and the search bar will appear. Start typing the name of the node and options will appear. Click on the correct node and it will insert into your patch.
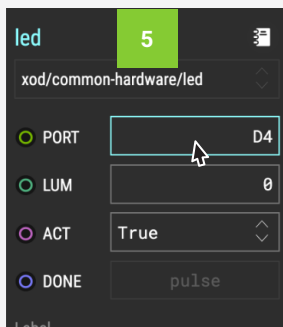
3. **KEYBOARD SHORTCUT**
   Similar to double-clicking the patch. Click anywhere on the patch and press 'i' on your keyboard. This will bring up the same search bar as above.
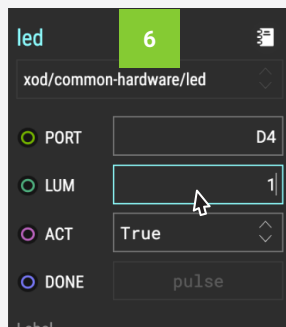
4. **MENU BAR**
   This is a third way to bring up the search bar. Select 'Edit > Insert Node...' from the menu bar.
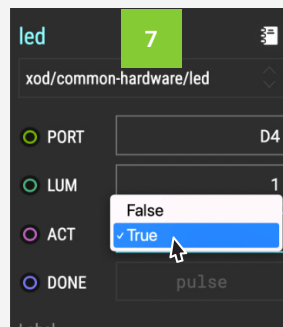
# Testing your Board

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### SET PORT PIN

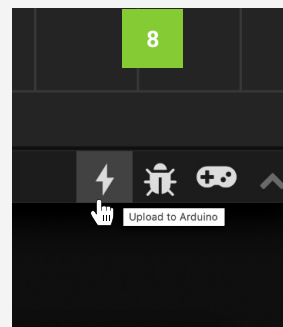The LED on the board is connected to port D4, so click on the text box next to PORT and set this to D4 by typing 'D4'.

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### SET LUM PIN

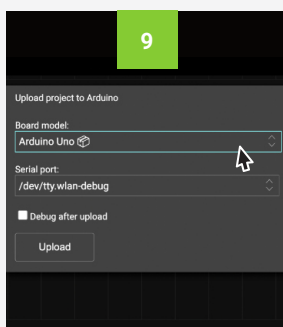LUM stands for luminance, i.e. how bright the LED is on a scale of 0-1. Set this to 1 (brightest level) by typing '1'.

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### SET ACT PIN

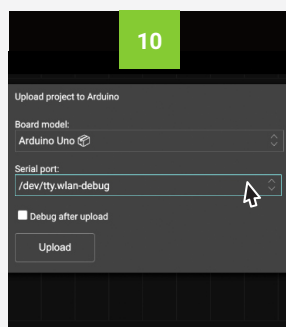ACT is a boolean pin that can only be true or false. Use the dropdown to set this to 'True'. This makes sure the LED responds.

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### UPLOAD

Click on the small lightening icon in the bottom right, or select 'Deploy > Upload to Arduino...' from the menu bar.
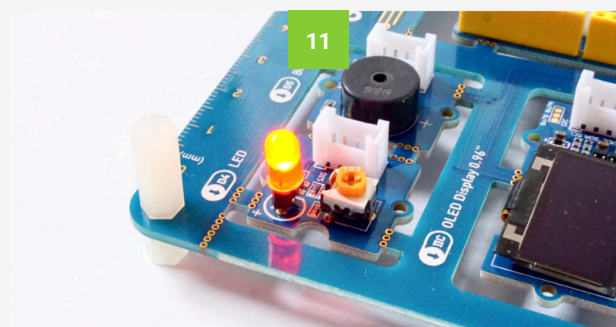
**9**



### SET BOARD MODEL

Use the dropdown menu to select 'Arduino Uno' or 'Arduino/Genuino Uno'.

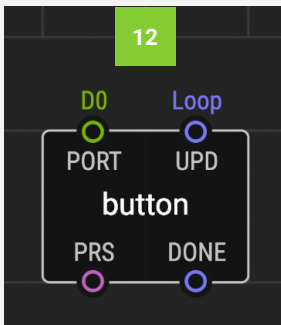**10**



### SET SERIAL PORT

Use the dropdown menu to select the option that ends in '(Silicon Labs)'.
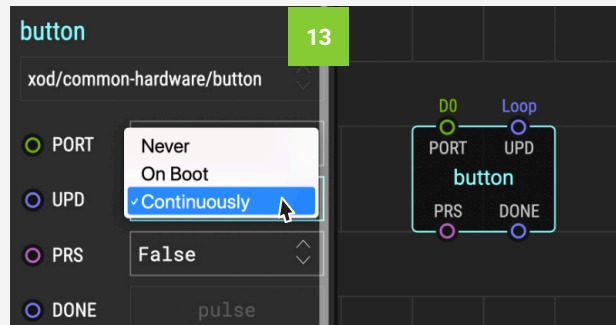
**11**



### WATCH YOUR LED!

Click upload and watch the LED on your board. It should light up!

If not, don't worry! Take a look at the Troubleshooting box on the next page (p25).

### ADD A BUTTON NODE

Now let's add another node. Using one of the ways described on p21, add a *button* node from the *xod/common-hardware* library.



### SET BUTTON PINS: UPD PIN

The UPD pin specifies how often the programme updates. This can be set to 'Never', 'On Boot (Boot)', or 'Continuously (Loop)'. Alternatively another node can be connected to this pin and used to determine how often it updates. Make sure this is set to 'Continuously (Loop)', so that whenever we press the button it is read instantly.
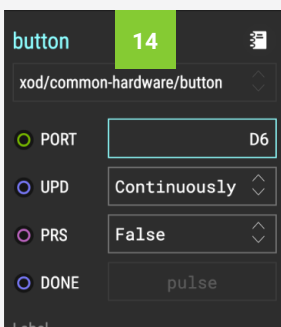


### SET BUTTON PINS: PORT PIN

As with the LED node, PORT specifies which port the button is connected to. Set this to 'D6'.
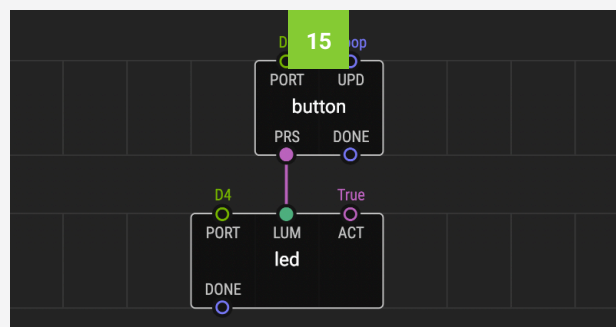


### CONNECT THE NODES

We want the LED to turn on whenever we press the button, so we need to connect the *button* output pin PRS (press) to the *led* input pin LUM. Do this by clicking on the PRS pin and then on the LUM pin. Now when you click on the *led* node you will not be able to set the LUM pin, because it's value is determined by *button* node.

# Testing your Board
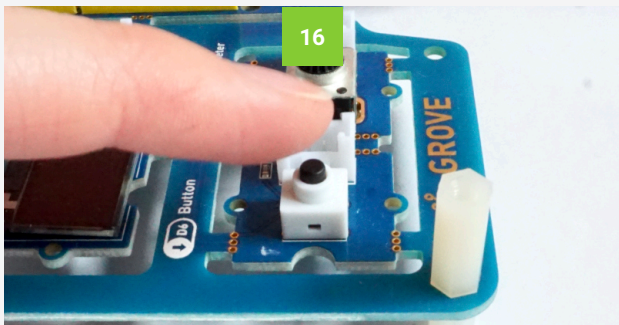


### UPLOAD AND TEST

Upload the patch and see what happens. You will notice that the programme is backwards. The LED is on and turns off when you press it. This is because the board's buttons are set to be on by default, and turn off when pressed. We can fix this programme with a logic node.
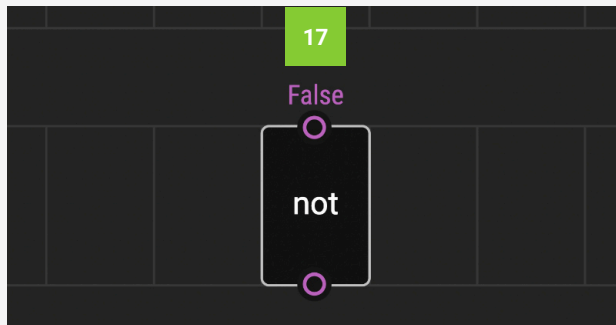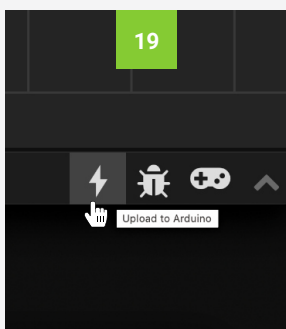


### ADD A NOT NODE

To invert the signal from the button we can use a different type of node that represent a logic function, rather than a piece of hardware. Insert a *not* node from the *xod/core* library.
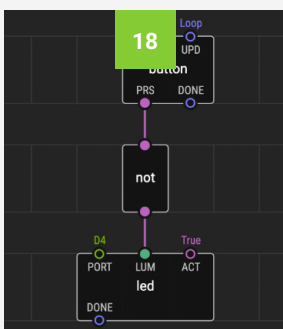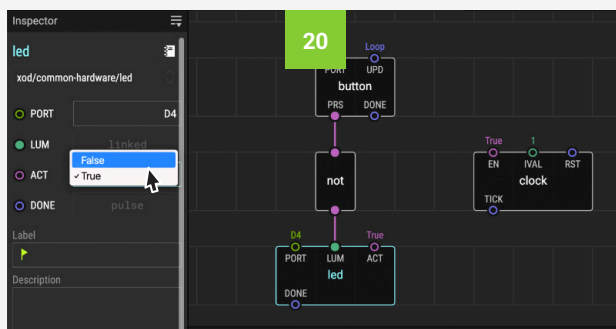


### REWIRE THE PATCH

Delete the link between the *button* and *led*. Connect PRS to the *not* input pin, and the *not* output pin to LUM.



### UPLOAD AND TEST

Now try uploading your programme again. This time it should work as planned.



### EXPERIMENT!

Congrats! you've now made a simple programme that uses an input (the button) and an output (the led) to affect change. Why not try experimenting with this patch? Play around with some pins. E.g. change the led ACT pin, or link a clock node to the button UPD pin and see what happens. See what you can achieve!
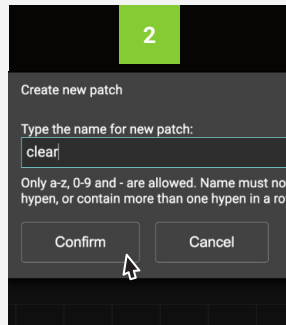
# Clearing the Board

Once a programme is loaded onto your board it will remain there and restart whenever you turn on the board. Each time you upload a new programme it will write over the previous programme. You don't need to clear the board before you upload a new programme, but if you wish to reset your board you can do this manually by uploading a blank patch in XOD.
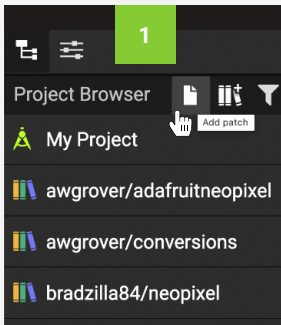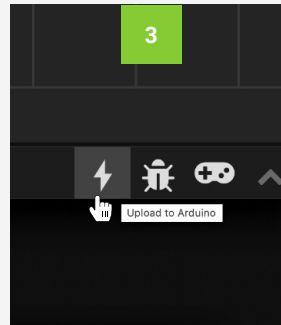
**MAKE A NEW PATCH**

Add a new patch by clicking the 'Add patch' button in the project browser or selecting 'File > New Patch…' from the menu.

**NAME THE PATCH**

Type a name for your new patch, e.g. 'clear' and click confirm or press the Enter key.

**UPLOAD**

Upload the empty patch by clicking the upload button as before. This will turn off the LED and clear the board.

# Troubleshooting

If your LED doesn't light up straight away there a few quick things to check:

1. **IS THE BOARD PLUGGED IN CORRECTLY?**
   If your board is plugged in correctly the power light on the right side of the Seeeduino module should light up. If not, make sure that the USB cable is plugged in fully.

2. **HAVE YOU SET YOUR NODE PARAMETERS CORRECTLY?**
   Setting the wrong parameters is a common mistake. In this case you should make sure the pins are set as follows:
   PORT = D4    LUM = 1    ACT = True

3. **HAVE YOU UPLOADED USING THE RIGHT BOARD MODEL AND SERIAL PORT?**
   After clicking the upload button you should make sure that you have the correct board model and serial port selected. Use the dropdown menus to select 'Arduino Uno'/'Arduino/Genuino Uno' and 'dev/tty.usbserial-0001 (Silicon Labs)'.

4. **DO YOU NEED TO INSTALL A USB DRIVER?**
   If XOD is not recognising your board, you may need to install a CP210 USB driver (see page 15).

Still need help? XOD provides *watch* and *tweak* nodes which are useful for troubleshooting and debugging your programme. Read more about them on page 27 of this guide, or take a look at XOD's guide to debugging at **www.xod.io/docs/guide/debugging**. For further help you can always contact the Biomaker team at synbio@hermes.cam.ac.uk.