

Block 3. Electronics

Module 1. Tools

1.1 Breadboard

A breadboard is a fundamental tool in electronics, allowing for rapid prototyping, circuit testing, and component integration without soldering. In neurotech applications, it enables the development of low-noise amplifiers, signal conditioning circuits, and biosensor interfaces, ensuring reliable testing before final implementation in brain-computer interfaces (BCIs) and neural recording systems.

Task: Watch this [video](#) and answer the following questions.

1. What is the primary function of a breadboard?
A) To permanently solder electronic components together
B) To quickly build and modify electronic circuits without soldering
C) To store electronic components
D) To test circuit resistance

2. Why are the power rails (buses) on a breadboard typically marked with red and black (or blue) lines?
A) To indicate where LEDs should be placed
B) To help identify the positive and negative connections for power distribution
C) To show where to insert integrated circuits
D) To separate different circuit components

3. What common mistake can prevent an LED from lighting up on a breadboard?
A) Placing the LED leads in different rows
B) Using a resistor in the circuit
C) Placing the LED in the correct row
D) Connecting the LED to the power rail

4. What is the advantage of using solid-core wire over stranded wire in a breadboard?
A) Solid-core wire is more flexible and bends easily
B) Solid-core wire is easier to push into the breadboard and holds connections better
C) Stranded wire is too thin to conduct electricity
D) Solid-core wire prevents short circuits

5. How should an integrated circuit (IC) be placed on a breadboard?
A) Across the power rails for maximum stability
B) Straddling the middle gap so each row is connected separately

- C) With all pins inserted into a single row
- D) At the very edge of the breadboard for easy access

1.2 Multimeter

A multimeter is an essential tool in electronics, used for measuring voltage, current, resistance, and continuity to diagnose circuit performance and troubleshoot faults. It is critical for verifying power supply stability, component integrity, and signal paths in both analog and digital systems. In neurotech applications, multimeters ensure precise readings in low-noise circuits, electrode connections, and biosensor calibration, helping maintain the accuracy and reliability of brain-computer interfaces (BCIs) and neural signal acquisition systems.

Task: Watch the following videos and learn how to use a multimeter. The videos have overlapping information, but they complement each other.

1. [Lesson 1](#)
2. [Lesson 2](#)

1.3 Oscilloscope

An oscilloscope is a vital tool in electronics, enabling real-time visualization of voltage signals for circuit debugging, signal integrity analysis, and frequency domain testing. It is crucial for examining waveforms, noise, and transient responses in analog and digital circuits, including low-noise amplifiers, ADCs, and power systems. In neurotech applications, oscilloscopes help analyze neural signals, ensuring precise synchronization, low-noise performance, and EMI reduction in brain-computer interfaces (BCIs) and biosensors.

Task: Watch the following videos and learn how an oscilloscope works. They cover everything from the basics to the science behind them, to how to use them.

1. [Lesson 1](#)
2. [Lesson 2](#)

Module 2. Development

2.1 Arduino

An Arduino is a versatile microcontroller platform used in electronics development for prototyping, automation, and signal processing through easy-to-use hardware and software. In neurotech applications, it facilitates the development of brain-computer interface (BCI) prototypes, biosignal acquisition systems, and neural stimulation devices, enabling rapid testing and real-time data processing for innovative neuroelectronic solutions.

Tinkercad is a free online tool that lets you design and test things like electronic circuits and 3D models. It's like a virtual workshop where you can build and play with electronics without needing actual parts. Arduino is a small computer that you can use to control things like lights,

motors, or sensors. Tinkercad works with Arduino by letting you build and test your Arduino projects on the computer first. You can make circuits and write simple code to control the Arduino, all in Tinkercad, before trying it out with real parts.

Task: Use this [link](#) to sign in to TinkerCAD. If you don't have an account, use your UT credentials to make one. Next, watch the videos below and follow the tutorials. Next, watch the videos below and follow the tutorials. Submit a screenshot of your progress as you follow along with the videos.

1. [Lesson 1](#)
2. [Lesson 2](#)
3. [Lesson 3](#)
4. [Lesson 4](#)
5. [Lesson 5](#)
6. [Lesson 6](#)

Task: Read through this [article](#), and follow the outlined steps. The goal is for you to feel comfortable with TinkerCAD, so do each step as many times as you need. Submit a screenshot of your final screen.

2.2 ESP32

The ESP32 is a powerful microcontroller with Wi-Fi and Bluetooth connectivity, ideal for electronics development, IoT applications, and real-time signal processing. In neurotech, it enables wireless brain-computer interfaces (BCIs), remote biosignal monitoring, and low-power neural data transmission, making it a key tool for developing portable and connected neuroelectronic systems.

Task: Watch the following videos and learn how an ESP32 can upgrade an Arduino.

1. [Lesson 1](#)
2. [Lesson 2](#)

2.3 Eagle PCB

Eagle PCB (Printed Circuit Board) design software is essential for electronics development, enabling the creation of custom circuit layouts, schematic design, and multi-layer PCB prototyping. In neurotech, it is used to design compact, low-noise PCBs for brain-computer interfaces (BCIs), biosignal amplifiers, and neural recording systems, ensuring high precision and signal integrity in advanced neuroelectronic devices.

Task: Watch this [video](#) to learn how to access Autodesk Eagle from Fusion 360, which you should have already downloaded in Block 1. Then, watch this [video](#) to learn how to make a PCB.

2.4 KiCad

KiCad is an open-source electronics design automation (EDA) software used for creating schematics and printed circuit boards (PCBs). In neurotechnology, it is valuable for designing custom PCBs for brain-computer interfaces (BCIs), neural stimulators, and biosignal acquisition devices. Its powerful tools support complex, high-density circuit layouts essential for integrating low-noise amplifiers, microcontrollers, and wireless communication modules.

Task: Use this link to download [KiCad](#) and watch this instructional [video](#).

Module 3. Implementation

3.1 Soldering

Soldering is the process of joining electronic components by melting a metal alloy (solder) to create a strong electrical connection between wires, circuit boards, and sensors. In neurotechnology, soldering is essential for assembling and repairing devices like EEG headsets, EMG-controlled systems, and neural implants, which rely on precise, low-resistance connections to accurately transmit bioelectrical signals.

Task: Watch this [video](#) to learn the basics of soldering

3.2 TIW Training: Basic Soldering Training (E1)

Task: Complete the “Basic Soldering Training (E1)” module on Canvas and submit a screenshot of completion.