



## Arduino Lesson ( )

### Use of DHT11 temperature & humidity sensor and OLED Display

Name: \_\_\_\_\_ ( ) Class: \_\_\_\_\_ Date: \_\_\_\_\_

**Objectives:** At the end of this lesson, you would be able to

1. Connect a DHT11 temperature & humidity sensor to the Arduino microcontroller
2. Write sketches to use DHT11 for measuring temperature and humidity
3. Show the information on an OLED display

#### **Apparatus:**

- 01 Arduino UNO microcontroller
- 01 USB cable
- 01 DHT11 temperature & humidity sensor
- 01 10 k $\Omega$
- 01 breadboard
- 10 male-male jumper wires
- 01 OLED display (SSD1306 0.96 inch, 128x64 pixels, I2C communication protocol) with pins

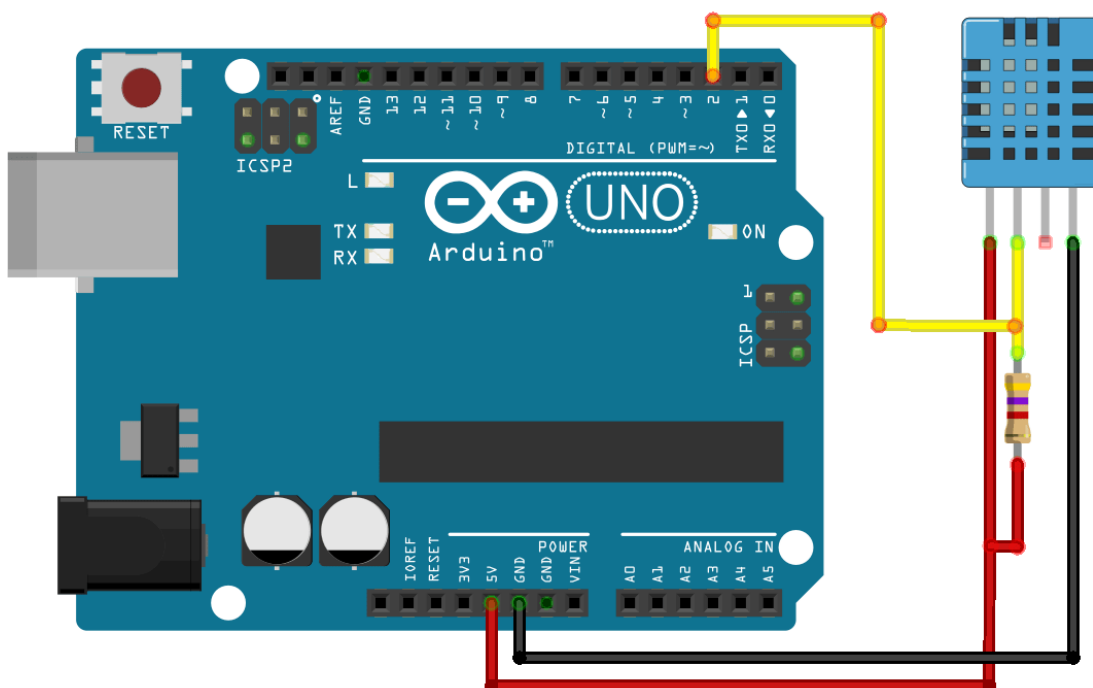
#### **Specifications of DHT11**

- DHT11 measures temperature with a surface mounted NTC temperature sensor (thermistor) built into the unit
- Temperature range: 0 to 50  $^{\circ}\text{C}$  ( $\pm 2$   $^{\circ}\text{C}$ )
- Humidity range: 20 to 90 % ( $\pm 5$  %)
- Sampling period: 1 second
- Smaller range and less accurate than DHT22

Reference: <https://randomnerdtutorials.com/complete-guide-for-dht11-dht22-humidity-and-temperature-sensor-with-arduino/>

- Measures relative humidity (= density of water vapour / density of water vapour at saturation) [%]

Reference: <http://www.circuitbasics.com/how-to-set-up-the-dht11-humidity-sensor-on-an-arduino/>



Above diagram from <https://randomnerdtutorials.com/complete-guide-for-dht11-dht22-humidity-and-temperature-sensor-with-arduino/>

### **Assignment 1:** Set up DHT11 with Arduino microcontroller

1. Insert the DHT11 sensor onto the breadboard. Set up the DHT11 circuit using the diagram shown on the previous page.

With the sensor facing you, pins 1 to 4, from left to right:

<b>DHT11</b>	→	<b>Arduino microcontroller</b>
Pin 1	→	5 V
Pin 2	→	digital pin 2 (or others, also connect a 10 kΩ pull-up resistor)
Pin 3	→	Don't connect
Pin 4	→	GND (ground)

2. Connect the Arduino microcontroller to the laptop and check for connectivity:

Select **Tools** → **Board:** “Arduino/Genuino Uno” & **Port:** “COM#”

3. **Install two libraries** into Arduino IDE (Integrated Development Environment):

*Sketch* → *Include Library* → *Manage Libraries*

- Type “**DHT**” in the search box and install the **DHT sensor** library from **Adafruit**.
- Type “**Adafruit Unified Sensors**” in the search box and install the **DHT sensor** library from **Adafruit** (or this may appear after installing DHT as “other dependencies to install”)

4. Copy, verify and upload the sketch given.

Select **File** → **New** to copy and paste the sample sketch.

5. Activate the **serial monitor** to show temperature and humidity readings.

### **Trouble-shooting:**

- Refer to <https://randomnerdtutorials.com/solved-dht11-dht22-failed-to-read-from-dht-sensor/>

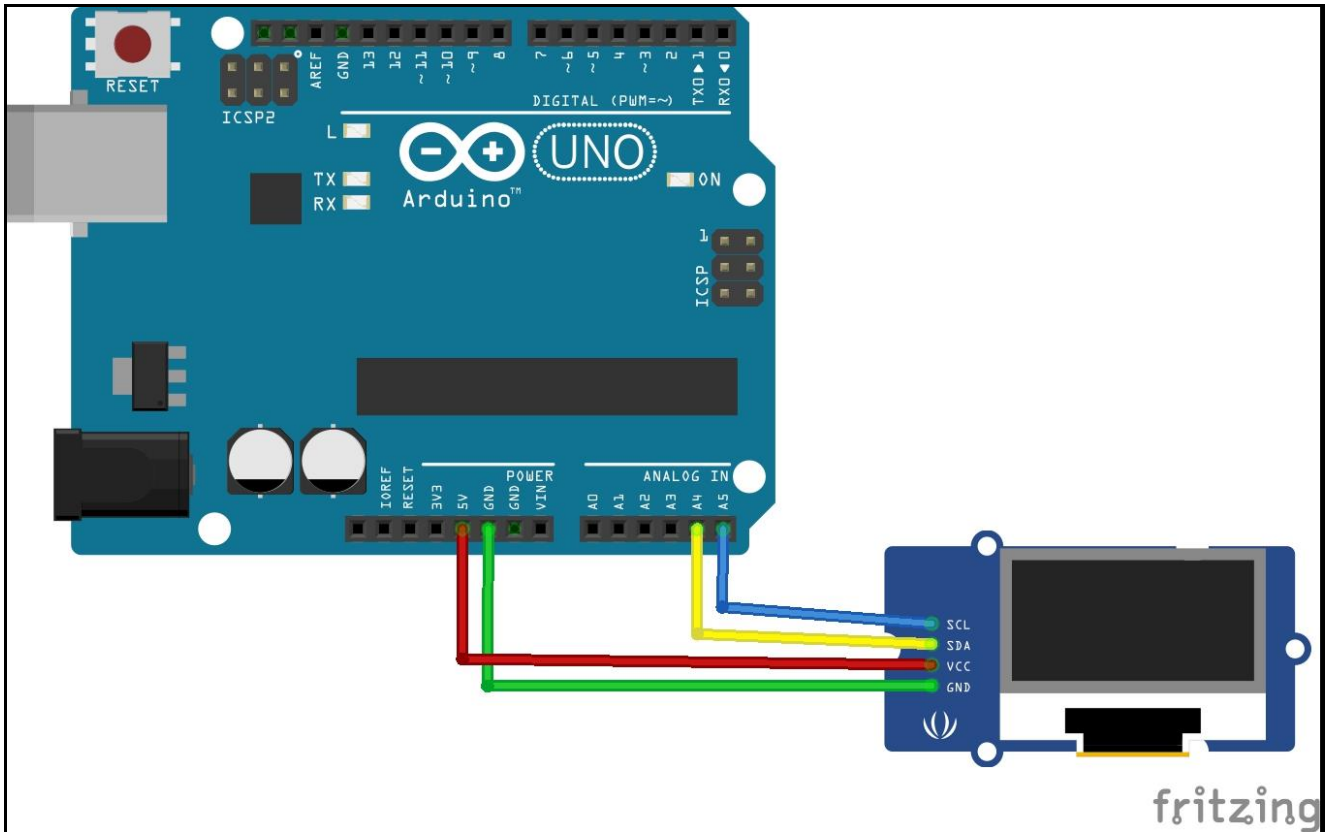
### **References:**

#### **Assignment 1:**

- <http://www.circuitbasics.com/how-to-set-up-the-dht11-humidity-sensor-on-an-arduino/>
- <https://randomnerdtutorials.com/complete-guide-for-dht11-dht22-humidity-and-temperature-sensor-with-arduino/>

#### **Assignments 2 & 3:**

- <https://randomnerdtutorials.com/guide-for-oled-display-with-arduino/>
- <https://www.instructables.com/id/OLED-I2C-DISPLAY-WITH-ARDUINO-Tutorial/>
- <https://lastminuteengineers.com/ds18b20-arduino-tutorial/>



Above diagram created with fritzing.org software

**Assignment 2:** Set up an OLED to display messages

1. Connect the OLED to the Arduino microcontroller using 4 female to male jumper wires in the following way:

<b>OLED</b>	GND	→	GND	<b>Arduino</b>
	VCC	→	5V	
	SDA (data)	→	A4 (Analog pin 4)	
	SCL (clock)	→	A5 (Analog pin 5)	

2. Connect the Arduino microcontroller to the laptop and check for connectivity:

Select **Tools** → **Board:** “Arduino/Genuino Uno” and **Port:** “COM#”

3. Install **two libraries** into Arduino IDE (Integrated Development Environment):

*Sketch* → *Include Library* → *Manage Libraries*

- Type “**SSD1306**” in the search box and install the **SSD1306 library** from Adafruit.
- Search for “**GFX**” in the search box and install the **adafruit\_GFX.h** libraries.

4. Select **File** → **New:** Copy & paste, verify and upload the given sketch to display the “Hello world!” message.

**Trouble-shooting:** If your OLED display is not showing anything:

- Check that the OLED display is properly wired to the Arduino
- Double-check the OLED display I2C address using Sketch A

**Assignment 3:** To display DHT11 temperature and humidity readings on the OLED

1. Modify the OLED sketch to display the temperature and humidity readings measurements taken by DHT11.
2. Select **File** → **New**: Copy & paste, verify and upload the given sketch to display the “Hello world! ” message.

**Assignment 1: Sample sketch**

```
/*Example testing sketch for various DHT humidity/temperature sensors
  Written by ladyada, public domain
  Modified by Ang JL 1 Feb 2020
*/

#include "DHT.h"
#define DHTPIN 2    // what pin we're connected to
#define DHTTYPE DHT11 // DHT 11

// Initialize DHT sensor for normal 16mhz Arduino
DHT dht(DHTPIN, DHTTYPE);

void setup() {
  Serial.begin(9600);
  Serial.println("DHT11 test!");

  dht.begin();
}

void loop() {
  // Wait a few seconds between measurements.
  delay(2000);

  // Reading temperature or humidity takes about 250 milliseconds!
  // Sensor readings may also be up to 2 seconds 'old' (its a very slow sensor)
  float h = dht.readHumidity();
  // Read temperature as Celsius
  float t = dht.readTemperature();

  // Check if any reads failed and exit early (to try again).
  if (isnan(h) || isnan(t)) {
    Serial.println("Failed to read from DHT sensor!");
    return;
  }

  Serial.print("Humidity: ");
  Serial.print(h);
  Serial.println(" %");          // println means start a new line after this
  Serial.print("Temperature: ");
  Serial.print(t);
  Serial.println(" *C ");
}
```

**Note:**

- Adapted from <https://randomnerdtutorials.com/complete-guide-for-dht11-dht22-humidity-and-temperature-sensor-with-arduino/> - From website, to paste into notepad first before pasting onto Arduino IDE.
- Upper & lowercase dht matters!

## **Assignment 2: Sample sketch to display “Hello world!” message**

### **Add to top of sketch**

```
#include <SPI.h>
#include <Wire.h>
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>

#define OLED_RESET 4
Adafruit_SSD1306 display(OLED_RESET);
```

### **Add to void setup()**

```
display.begin(SSD1306_SWITCHCAPVCC, 0x3C);
display.clearDisplay();
```

### **Add to void loop()**

```
display.clearDisplay();
display.setTextSize(1);
display.setTextColor(WHITE);
display.setCursor(0,0);
display.println("Hello world!"); // can replace with text or reading from sensor
// or value from math function
display.display();
```

## **Assignment 3: Sample sketch to display DHT11 readings**

### **Add to void loop()**

```
display.clearDisplay();
display.setTextSize(1);
display.setTextColor(WHITE);
display.setCursor(0,0);

display.println("Humidity: "); // display humidity in %
display.print(h);
display.print(" ");
display.println("%");

display.println("Temperature: "); // display temperature in deg C
display.print(t);
display.print(" ");
display.cp437(true); // code page 437
display.write(167); // character 167 is degree symbol
display.println("C");

display.display(); // for the changes to make effect
```

**Note:** Other special symbols (characters) available are shown on <https://www.ascii-codes.com/>