

# Environmental Science Raspberry Pi Workshop

The Raspberry Pi can be used in environmental science projects by connecting to the internet and getting data from various websites (weather.com, etc.) or by attaching a sensor to get real-time data from the environment. Focus for today: SenseHat, which comes installed as part of NOOBS. Other sensors can be purchased to measure pH, CO2, IR, etc. Examples:

<https://tutorials-raspberrypi.com/raspberry-pi-sensors-overview-50-important-components/> (<https://tutorials-raspberrypi.com/raspberry-pi-sensors-overview-50-important-components/>)

<https://www.hatarilabs.com/ih-en/8-environmental-sensors-for-raspberry-pi-that-you-can-buy-on-ebay>.  
(<https://www.hatarilabs.com/ih-en/8-environmental-sensors-for-raspberry-pi-that-you-can-buy-on-ebay>)

The Sense HAT has an 8×8 RGB LED matrix, a five-button joystick and includes the following sensors:

- Gyroscope
- Accelerometer
- Magnetometer
- Temperature
- Barometric pressure
- Humidity

To simulate conditions, use the online emulator at [trinket.io/sense-hat](http://trinket.io/sense-hat)

## SenseHat Basics and Rainbow Predictor

We are going to gather and print out the data that we get from the SenseHat sensors.

First, import libraries and find the SenseHat. Next, define the colors and try displaying a message.

```
In [ ]: from sense_hat import SenseHat
import time

sense = SenseHat()

sense.show_message("???", scroll_speed = 0.06, text_colour = G)
```

We can get the sensor data by calling on each of the sensor functions and then printing out the values.

```
In [ ]: orientation = s.get_orientation()
pitch = orientation["pitch"]
roll = orientation["roll"]
print("---Orientation---\npitch: %d roll: %d" % (pitch, roll))

accelerometer = s.get_accelerometer_raw()
x = accelerometer['x']
z = accelerometer['z']
print("---Acceleration---\nx: %d z:%d" % (x, z))

t = s.get_temperature_from_pressure()
h = s.get_humidity()
print("Temperature: " + str(t))
print("Humidity: " + str(h))
```

To use some of these sensors and their outputted data, we are going to make a basic program that detects if there is a chance of a rainbow forming with the current conditions. We will first define the colors and a pattern that represents a rainbow.

```
In [ ]: G = (0, 255, 0)
R = (255, 0, 0)
B = (0, 0, 255)
O = (255,165,0)
Y = (255,255,0)
V = (75,0,130)
I = (123,104,238)
X = (255, 255, 255)

rainbow = [
R, R, R, R, R, R, R, R,
R, O, O, O, O, O, O, O,
R, O, Y, Y, Y, Y, Y, Y,
R, O, Y, G, G, G, G, G,
R, O, Y, G, B, B, B, B,
R, O, Y, G, B, I, I, I,
R, O, Y, G, B, I, V, V,

R, O, Y, G, B, I, V, X
]
sense.set_pixels(rainbow)
```

Now we can tell the pi when to display this rainbow. The conditions are taken from the sensors. If using the emulator instead, use the variables `sense.temp` and `sense.humidity` to get the simulated conditions.

```
In [ ]: while True:
        if sense.get_humidity() > 80 and sense.get_temperature() > 20 : #threshold of conditions
            sense.set_pixels(rainbow)
        elif sense.temp > 80 :
            sense.clear(Y) #makes the display yellow for sun if it's hot
        else:
            sense.clear()
```

Now that we know how to use the sensors, there are endless possibilities of projects to do with them! Here are some examples that you can try out:

- cover the raspberry pi with a bottle then squeeze -> analyze and graph the pressure change
- make a compass
- calculate temperature from pressure data then use the sensors to verify

There is also example code online to help you! <https://github.com/RPi-Distro/python-sense-hat/tree/master/examples> (<https://github.com/RPi-Distro/python-sense-hat/tree/master/examples>)