Lesson Planning Template **Teacher: DeSIRE**

📆Date:	Topic: Distance Measurement	Time Required: 90 minutes

🎯**Learning Target/Objectives:**

- **I can** successfully compile and upload an Arduino sketch that enables ultrasonic distance sensing and OLED data visualization .
- **I can** explain how a robotic system uses ultrasonic waves to measure distance and provide different visual alerts based on mathematical ranges.
- **I can** modify RGB (Red, Green, Blue) code parameters to customize the visual feedback a robot provides when detecting an object .

📜**Vocabulary:**

- **Ultrasonic SensorOLED Screen**
- **RGB Data**
- **Done Compiling**
- **Done Uploading**
- **Milliseconds (millis)**

❓**Guiding Questions:**

- How does the robot "see" distance using sound waves compared to how humans use their eyes?
- Why is the OLED screen a valuable addition for a robotics engineer when testing an autonomous program?
- In the code, what happens if an object is exactly 10 cm away? Which color would the sensor display based on the logic table?
- How would you change the "timer" value in the code to make the robot detect objects more frequently?

📚**Lesson Design Details:**

- **Activity 1: The Invisible Ruler**
  - **Focus:** Students move a block at various distances in front of the sensor. They must record the OLED reading and verify if the LED color matches the data table (Red for 5-7cm, etc.) .
- **Activity 2: The RGB Color Remix**
  - **Focus:** Students navigate to line 101 in the `distance.ino` file. They must modify the RGB values to create a unique color (like Purple or Yellow) for the 5-7cm range and re-upload the program.
- **Activity 3: Range Extension Math**
  - **Focus:** Students modify the mathematical conditions in the code (e.g., changing `distance > 19` to `distance > 30`) to see if they can make the robot detect objects from further away.

Key Points (Vocabulary):

- **Ultrasonic Sensor:** A device that measures distance by emitting high-frequency sound waves and timing the reflection (echo) off an object.
- **OLED Screen:** A small, high-contrast digital display used to show real-time numerical data collected by the sensors.
- **RGB Data:** A numerical system representing the colors Red, Green, and Blue; used in code to control the color of the sensor's lights.
- **Done Compiling:** A status message in the IDE indicating that the software has verified the code is written correctly .
- **Done Uploading:** A status message indicating that the computer has successfully "burned" the program into the robot's brain .
- **Milliseconds (millis):** A timing function used in the code to control how often the sensor takes a measurement (e.g., every 250ms).

Key Points of Instruction

- **Sensory Feedback Loop:** Explain that the ultrasonic sensor is the "Input," the Arduino code logic is the "Process," and the OLED screen/Colored LEDs are the "Outputs" .
- **Range Logic:** Focus on the `if-else if` statements. Help students understand that the robot checks distances in specific "buckets": 5-7cm, 12-14cm, and 19-21cm .
- **RGB Color Mixing:** Instruct students that the `ultrasound.Color` function uses values between 0 and 255. For example, `(255, 0, 0, 255, 0, 0)` is pure Red .
- **Safety Protocol:** Remind students not to cover the ultrasonic sensors with objects for long periods to prevent sensor fatigue or errors.

Teacher's Cheat Sheet	
Technical Feature	**Data Point / Required Action**
Sketch File	distance.ino
Memory Usage	Approx. 23368 bytes (72% of storage)
Red Range	5 to 7 cm
Green Range	12 to 14 cm

Blue Range	19 to 21 cm
Update Frequency	Every 250 milliseconds
RGB Code Format	(R, G, B, R, G, B)

Category	Standard Organization	Standard/Benchmark Code and Description
Computer Science	NCSOS	**HS-CS-03:** Illustrate the ways computing systems implement logic, input, and output through hardware components
Technology	ITEEA	**STEL-2R:** Follow step-by-step instructions to safely use systems and troubleshoot common problems
Engineering	ITEEA	**STEL-2V:** Analyze the stability of a technological system and how it is influenced by components in the feedback loop
Digital Literacy	ISTE	**1.5.d:** Students understand how automation works and use algorithmic thinking to develop a sequence of steps
Mathematics	NCSOS	**NC.M1.G-CO.2:** Represent transformations in the plane through coordinate and distance measurements.