Lesson Planning Template **Teacher: DeSIRE**

📆Date:	Topic: Start xArm 1S	Time Required: 30 minutes

🎯**Learning Target/Objectives:**

- I can install the required software to run the xArm robot.
- I can control the functions of the xArm robot.

📜**Vocabulary:**

- Serial Bus Servo.
- Asynchronous Serial Bus
- Closed-Loop Control
- Potentiometer
- Baud Rate
- Torque
- Neutral Position (Middle Position):

❓**Guiding Questions:**

- Why is a vacuum pad necessary for a robotic arm even if the arm is not moving heavy objects?
- How does the "beep" alarm act as a protective measure for the delicate electronic components inside the servos?
- Why would a standard 5V USB port be insufficient to power the xArm 1S compared to the provided power adapter?

📚**Lesson Design Details:**

- **Activity 1: Activity 1: The "Chain of Command" Wiring Challenge**
  - **Objective:** Understand the difference between traditional wiring and serial bus communication.
  - **The Task:** Students are given a diagram of a traditional PWM servo setup (where every motor has its own wire back to the controller) and the xArm 1S "daisy-chain" setup.
- **Activity 2:** Ask students to map out the wiring for all 6 servos. They must explain how Servo ID 1 (the gripper) receives a command even though it is at the end of the physical chain.
  - **Discussion:** Discuss the benefit of "reducing the occupation of the serial port".
- **Activity 3: The "Neutral Zone" Calibration Lab**
  - **Objective:** Explore the importance of the "middle position" and potentiometers in closed-loop systems.
  - **The Task:** Before "assembling" a virtual or physical arm, students must simulate the "Initial Zero Point"[6].
  - **Activity:** Using a protractor, students must identify the middle point for a 240-degree rotation (LX-15D) versus a 320-degree rotation (Bottom Servo ID 6).
  - **Critical Thinking:** Have students write a "Warning Label" for a junior engineer explaining what happens when a potentiometer enters the "blind zone"
- **Activity 3: The "Robot Health" Dashboard (Data Literacy)**
  - **Objective:** Interpret real-time data feedback from the hardware
  - **The Task:** Using the "Servo Parameters" table, students act as "System Monitors"

- **Activity:** Provide students with a scenario: "Servo ID 3 is operating at 8.5V and the temperature is rising. Students must use the technical specs to determine if the servo is in danger (comparing it to the 6-8.4V operating range)
- **Math Integration:** Students calculate the torque difference when the arm moves from 6V to 7.4V (15kg.cm} vs 17kg.cm).

Key Points (Vocabulary):

- **Vacuum Pad (Suction Cup):** A stabilization component used to secure the robot base to a flat surface via suction.
- **Adapter Connector:** The specific interface that joins the external power supply to the robot's controller.
- **DC Power Interface:** The port on the controller designed to receive Direct Current power.
- **Low-Voltage Alarm:** A safety feature that triggers an audible sound when the power supply drops below a safe threshold.
- **Initialization:** The startup sequence where the system performs a self-check, indicated by flashing LED lights.
- **Controller LED:** Visual indicators on the circuit board that confirm the presence of power and signal.

Key Points of Instruction

- **Mechanical Stability First:** Before turning on the power, the robot must be physically secured. Teaching students to tighten the nuts on the vacuum pads prevents the robot from tipping during high-torque movements.
- **Voltage Discipline:** The xArm 1S is sensitive to power levels. Students must understand that while a USB port might fit a connector, it only provides 5V, which will trigger the low-voltage alarm.
- **Visual Diagnostics:** Train students to look for the "Normal Working State". If the LED1 (Power) and LED2 (Signal) are not both on, the system is not ready for commands.
- **The "Beep" Protocol:** Establish a classroom rule that if a "beep" is heard, the power switch must be turned off immediately to prevent servo damage.

Teacher's Cheat Sheet	
● **Alarm Threshold**	Beeps if power is less than 6.4V.
● **USB Power Note**	USB 5V is INSUFFICIENT; triggers alarm
Correct Power Source	Use ONLY the provided adapter

Power Indicator	LED1 on the controller must remain on
Signal Indicator	LED2 on the controller must remain on
Servo Readiness	Indicators will flash in colors during startup.
Startup Sequence	Connect wiring -> Switch on -> Check LEDs

📝**Materials/Resources:**

- Digital Journal (Google Slides RECOMMENDED):

📋**Closing (Check for Understanding):**

- Discussion Review - students will share
  - Answers to Guiding Questions
  - Any surprises they experienced

Category	Standard Organization	Standard/Benchmark Code and Description
Technology	ITEEA	STEL-2R: Follow step-by-step instructions to safely use systems and troubleshoot common problems.
Computer Science	NCSOS	HS-CS-02: Design and implement strategies for troubleshooting hardware and software problems.
Engineering	ITEEA	STEL-7Q: Apply a broad range of making skills to follow a design process in the construction of a prototype.
Digital Literacy	ISTE	1.1 Empowered Learner: Students demonstrate a sound understanding of technology concepts, systems, and operations.
Science	NCSOS	PHY.2.2.3: Analyze the relationship between voltage, current, and resistance in a DC circuit.