Lesson Planning Template **Teacher: DeSIRE**

📆Date:	Topic: Adjust Deviation	Time Required: 45 minutes

🎯Learning Target/Objectives:

- I can control the functions of the xArm robot.
- I can improve the accuracy of the xArm by adjusting the servos.
- I can describe the performance of the xArm using mathematical terms.

📜Vocabulary:

- Deviation
- Reset Servo
- Main Shaft Bracket:
- Servo Horn
- Parallel
- Download Deviation

❓Guiding Questions:

- Why might two identical robots have different physical deviations even if they were built using the exact same instructions?
- If a robot's deviation is not adjusted, how might that affect its ability to complete a complex task like stacking blocks?
- What is the mathematical threshold that determines if we can fix a robot's alignment using software or if we must physically take it apart?

📚Lesson Design Details:

- **Activity 1: The Parallel Line Inspection**
  - **Focus:** Students perform a "Reset Servo" and use a ruler or straight edge to check if the main shaft brackets are perfectly parallel. They must document which servos (ID 1 through 6) are misaligned.
- **Activity 2: The Slider Calibration Challenge (Small Deviation)**
  - **Focus:** Using the PC software, students practice moving the software sliders to align the robot's joints until they are in a perfectly straight line.
- **Activity 3: The Mechanical Re-Set (Large Deviation)**
  - **Focus:** Students simulate a "Large Deviation" by purposely misaligning a joint and then following the five-step mechanical repair process: unscrewing, rotating, and re-securing.

Key Points (Vocabulary):

- **Deviation:** The measurable difference between the robot's actual physical position and its programmed "middle" or "zero" position.
- **Reset Servo:** A software command that forces all motors to return to their internal default center point.
- **Main Shaft Bracket:** The mechanical part that connects the motor's rotating axle to the rest of the robot arm.
- **Servo Horn:** A small attachment that fits onto the servo's output shaft to transmit motion to

the arm's joints.

- **Parallel:** A geometric state where two parts of the robot (like brackets) are aligned in the same direction and never intersect.
- **Download Deviation:** The process of permanently saving digital calibration data from the PC software onto the robot's hardware controller.

Key Points of Instruction

- **The "Visual Zero" Concept:** Teach students that "Zero" in software must match "Straight" in the physical world. If the robot looks crooked after a "Reset Servo" command, a deviation exists.
- **Software vs. Hardware Solutions:** Students must distinguish between "Small Deviation" (under 30 degrees) which is fixed by clicking sliders , and "Large Deviation" (over 30 degrees) which requires a screwdriver and mechanical re-alignment.
- **Force Management:** Emphasize that when separating the servo shaft from the bracket, students must not use excessive force to avoid deforming the metal or plastic parts.
- **The "Permanent Save":** Instruction should highlight that clicking "Download Deviation" is essential; otherwise, the robot will "forget" its calibration as soon as it is turned off.

Teacher's Cheat Sheet

Calibration Type	Numerical Value	Angular Limit	Required Action
Normal / No Error	0	0 degrees	None needed
Small Deviation	1 to 100	Up to 30 degrees	Software slider adjustment
Large Deviation	Over 100	Over 30 degrees	Mechanical re-installation

📝**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-2V: Analyze the stability of a technological system and how it is influenced by components in the feedback loop
Mathematics	NCSOS	NC.M1.G-CO.2: Represent transformations in the plane; specifically identifying parallel lines and collinear points
Digital Literacy	ISTE	1.1 Empowered Learner: Students use technology to seek feedback that informs and improves their practice