Unit 3: Using Inputs and Outputs

Mission 11: Spirit Level

Intro and Discussion Points:
How level is your desk or table? Write some code to find out! In this project you'll build a spirit level! This is more than just a fun project – it's a useful tool with practical applications.

Discuss how a real *mechanical* **spirit level** works. The "spirit" is a liquid with space for a bubble, which will be in the center of the tube when it's in a **horizontal** position.

Students will create a digital level using the CodeX's built-in accelerometer and LCD display. Physically rotating the CodeX will move the digital "bubble" they create on the display, with **code**!

CodeX Lesson Plans

UNIT 3: Using Inputs and Outputs	**MISSION 11: Spirit Level**	**# DAYS:** 2
UNIT GOALS: Students will use the CodeX sensors to create programs with real-world applications.	**ADDITIONAL MATERIALS:** ● none	**VOCABULARY:** ● Comment ● Accelerometer ● Pixel

FOCUS CSTA STANDARDS: 1B-AP-17, 2-AP-19, 3A-DA-11, 3A-AP-17, 3A-IC-26

LEARNING TARGETS:

- I can use comments to explain and document the purpose of each line of code.
- I can use variables to calculate and convert measurements.

SUCCESS CRITERIA:

- ❏ Display a numeric "tilt" value from the accelerometer.
- ❏ Scale the raw tilt value to show 0-9, indicating 0° to 90° incline.
- ❏ Replace the number display with a graphical bubble simulation!

KEY CONCEPTS:

- Meet the accelerometer. There's one in your cell phone, and in many other devices we use. What is acceleration, and what does that have to do with "horizontal"?
  - Make sure students read the accelerometer toolbox entry!
- Units conversion! Convert arbitrary units generated by the accelerometer into degrees.
- Use a bit o' math for scaling the degrees to a range suitable for the moving "bubble".
- Setting individual pixels on the display, using `display.set_pixel()`.
  - Note: pixel is a contraction of "picture element"

DISCUSS REAL WORLD APPLICATIONS:

Let students have a few minutes to play with the spirit level. If they disconnect the USB cable and connect the batteries, they can measure the levelness of various items in the room.

Accelerometers used as tilt sensors are important and used every day for:

- Controlling your phone screen (landscape or portrait)
- Building a house
- Flying Airplanes
- Keeping Solar Panels pointed at the Sun

ASSESSMENT STRATEGIES:

Remix suggestions (set aside 0.5-1 period to complete):

- Display a special symbol when level is at the zero mark.
  - Example: `Image.TRIANGLE`.
- Adjust the sensitivity, so you can measure precise levels near 0°.
  - Hint: `scaled = (tilt / 1024) * 100`
  - Bonus: enable *high-sensitivity* mode only when a button is pressed.

TEACHER NOTES:

Always refer to **Answer Keys by Mission** if you get stuck. All coding solutions are available, in alphabetical order.