To make it easier for Penelope to control the lights in the dark, the light switches themselves might be illuminated in the dark to show her the relative placement of the controls. This way, by looking to see what positions the switches are relative to each other, she can easily figure out which controls need to be slided up, and which ones need to be slided down during her presentation.

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Question 3: **Formal Experiment Design and Interpretation**

Problem Statement:
East Bay MUD wants to start using handheld devices to record water usage meter readings. They want to find out which type of device (stylus vs. keypad; color vs. black-and-white) would be the most effective solution.

Hypothesis:
1. Use of the stylus to input readings will yield much faster response times, and less errors than the keyboard, once the participant gets used to it (a learning effect).
2. Because of a learning effect, each successive repetition of the tasks will result in faster response times.
3. Black & white screens might yield slightly faster recording times and less errors, particularly in outdoor glare situations.

Independent Variables:
- Screen color, with two levels: black-and-white and color
- Input device, with two levels: stylus vs. keypad

Dependent Variables:
- time required to record the reading
- number of errors

Tasks:
1. read water meter
2. record reading (using given input method: stylus or keyboard)

Methodology:
Blocking. The 32 participants will be split up into two groups of 16. One group of 16 will use the stylus for recording the readings of four different meters. The other group of 16 will use the keypad to perform the tasks on four different meters. Both groups will use varying color screens for each task: the first two trials will be on one screen color type, the other two will be on the other screen color type. As a result, each individual in this group will perform tasks A and B a total of 4 times (on four different meters).

In this test, the “between-subjects” factor is the input method (stylus vs. keyboard), because there may be an associated learning effect. The screen color type (black-and-white vs. color) will be the “within-subjects” test factor as there probably will not be an associated learning effect observed. Please refer to the Latin square below for clarifications on how the blocking was set up, and what

each set of 16 subjects will be doing.

16 subjects will do all tasks in this column	The other 16 subjects will do all tasks in this column
Keypad only	**Stylus only**
Meters 1 & 2 using color screen	Meters 1& 2 using black & white screen
Meters 3 & 4 using a black & white screen	Meters 3 & 4 using a color screen

Because each group of 16 participants will only be using either a keypad or stylus, learning effects should be accounted for using this methodology. Each participant will be performing the reading and recording tasks 4 times. There will be 16 participants using 1 level (keypad only or stylus only) of input device, and 16 using the other input device. Each of these 16 participants will use 2 levels of screen color types (both color and black-and-white screens).

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