# Invisible Blues (Novel Device for Detection and Measurement of Nitrogen Traces in a Sample) 

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Surplus nitrogen's runoff causes numerous environmental hazards, such as algae blooms, which endangers marine wildlife. Currently, farmers use 60-cent single-use test strips (returns qualitative 'good' or 'bad') to confirm levels of nitrogen in their soil. I aspired to design \& build a device - more accurate, cost-effective, reusable, time-efficient, and sustainable - to detect nitrogen concentration in the soil. (a)Through iteration, I designed a spectrophotometer (my 'darkbox') to fit a cuvette and positioned receivers \& emitters (LEDs $-615 \mathrm{~nm} \& 850 \mathrm{~nm}$ ) in their optimal positions. (b)I made circuits (transistors, voltage dividers) \& custom C++ logic in the microcontroller to handle connections to multiple LEDs in rapid succession. My code processes the data (averages, etc), returning a relatively error-free value. (c)Through experimentation with various nitrogen sample solutions (after copper-electrolysis; 5 min ) - made of $\mathrm{NH} 4 \mathrm{OH}, \mathrm{Mg}(\mathrm{NO} 3) 2$, inorganic fertilizer, organic potting soil, or combinations) I produced a linear relationship between received absorbance intensity \& molarity. After calibration and fine tuning, my devices: 1) detected traces of nitrogen in forms of ammonium \& nitrate, 2) disregarded both sulfate's \& turbidity interference: all cornercases passed! My device meets all design criteria: $\$ 20$ initial investment (lower cost than current after 30 uses), reusable, time efficient, and sustainable beyond current practices. Accuracy: can identify the significance [surplus; shortage; optimal] \& molarity [with vs without sulfur, accurately predicts: ammonium (99.79\%) \& nitrate (92.94\%)]. Usage: To test an electrolyzed sample, (1)place it into the 'darkbox', (2)read the molarity of the sample off the LCD board within 20 seconds!

## Awards Won:

Third Award of \$1,000

