

## Why use smartphones (in a physics lab)?

Students are conjoined to the smartphone in their pocket; can teachers make it a pocket laboratory? We believe the answer can be and should be yes. Smartphones have the hardware with computational power to perform the number crunching, data acquisition and hi-res graphics required for real-world experiments. And software apps exist that harness that hardware. Missing are the instructions for using apps in the lab. With proper instructions and a smartphone, many experiments that have long been a staple of the classroom lab can now be done almost anywhere.

What is needed for smartphone labs? Often only a little imagination and ingenuity. As the labs of this workshop illustrate, many classic experiments are possible with extra equipment no more exotic than tape, thread and scissors.

Creating workshop labs demonstrated the potential and challenges of smartphone use. Finding the apt app is the key hindrance, as most apps are designed for the consumer entertainment market, and few data acquisition apps were designed with science experiments in mind. But apps do exist that are adaptable to science education.

The workshop labs use apps in two ways:

1. Standalone apps, such as the Physics Toolbox Accelerometer or Magnetometer, or the Mobile Science AudioTime+, that allow data acquisition, display and analysis completely on the smartphone. Additionally, many data acquisition apps write a spreadsheet file for analyzing on a computer. These allow teachers with no special knowledge of smartphones to create labs. However, using a computer for analysis adds extra steps and equipment for the students to manage.
2. Combined apps for data acquisition and spreadsheet analysis all on the smartphone. This approach uses three separate apps: a stand alone app for data acquisition to a file, a second for simple signal processing on that file to extract the relevant data and update a spreadsheet file, and a spreadsheet app to display the results. This approach is most manageable for students performing the labs since the smartphone does all data collection and analysis.

One example of this approach uses the Physics Toolbox Magnetometer app to collect and write magnetometer data to a file, the Mobile Science Magnetic Field app analyzes and writes that data for each collection step (Figure 1) to a spreadsheet, a spreadsheet app then opens the spreadsheet with data values, graph of the fitted values (Figure 2), etc.

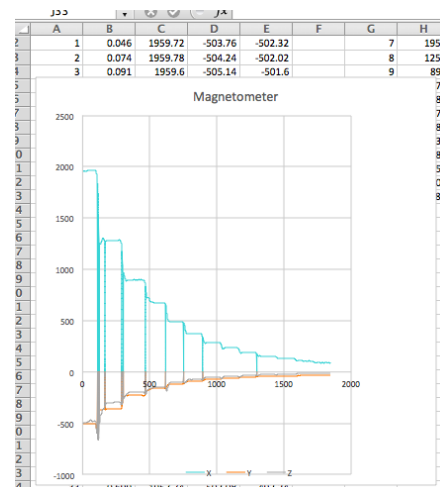


Figure 1 - Magnetometer level values

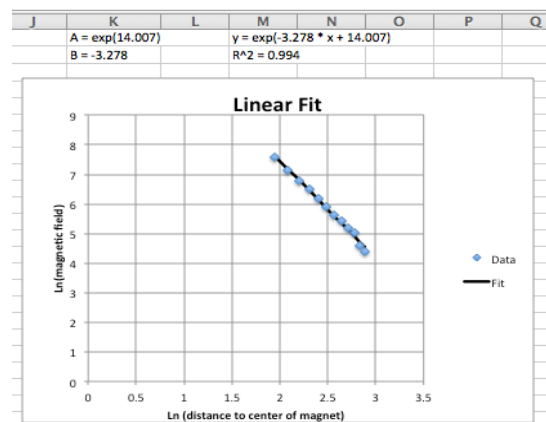


Figure 2 - Magnetometer linearized data fitted graph