A One-Hour DE Application on the TI NSpire

Jeff Kallenbach
Tim Husband
Siena Heights University

Background

- We use technology throughout the program
  - Smartboard for presentations
  - TI NSpire CAS is handheld of choice
    - Supplements, enrichment, checking, rote tasks
  - Maple for the heavier work

TI Value-addeds

- Product is maintained well (software)
- TI is popular
- As such it has
  - Large collection of pre-fab activities
  - Partners and peripherals

Highlights of the DE I Course

- Applications of previous work
- Applied Math
- Writing
- Maple as a tool

Newton's Law Of Cooling

- Newton's Law

$$T'(t) = k(A - T)$$

- Prerequisites
  - About 2-3 weeks of DE I
  - Integration of ln form
- Result
  - Exponential growth/decay

The Experiment

- Setup
  - TI Emulator Software & Smartboard, or handheld
  - Bucket of ice
  - Three vials of liquid with different cooling constants, at room temp
  - Three-port temperature probe – Vernier/Easy Link
  - Writing tool (Latex/Word & MathType/…)
  - One 50-min class period

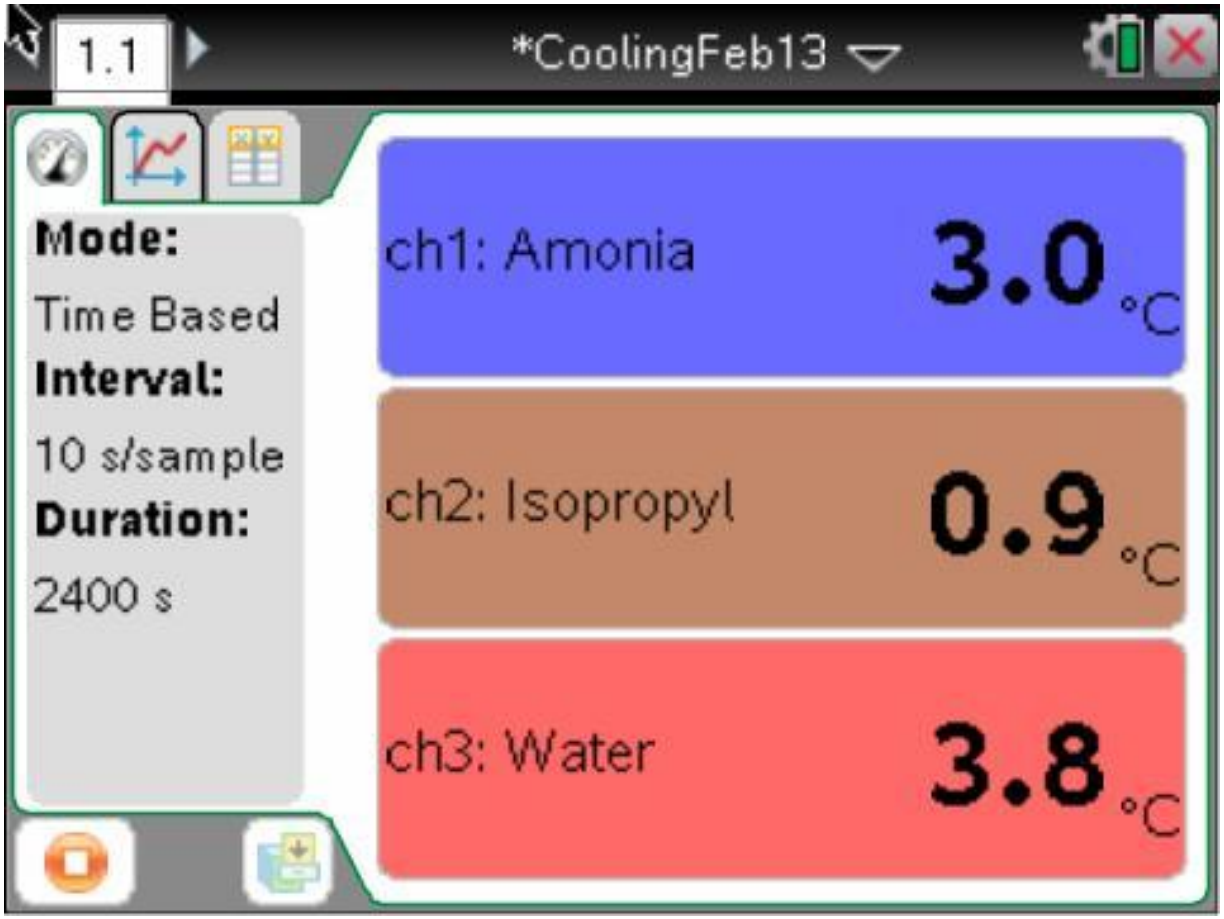
The Process

- Bring your medium to $0^{o}C$
- Check and record the ambient temp A
- Press the button to start the collection
- Dunk the solutions

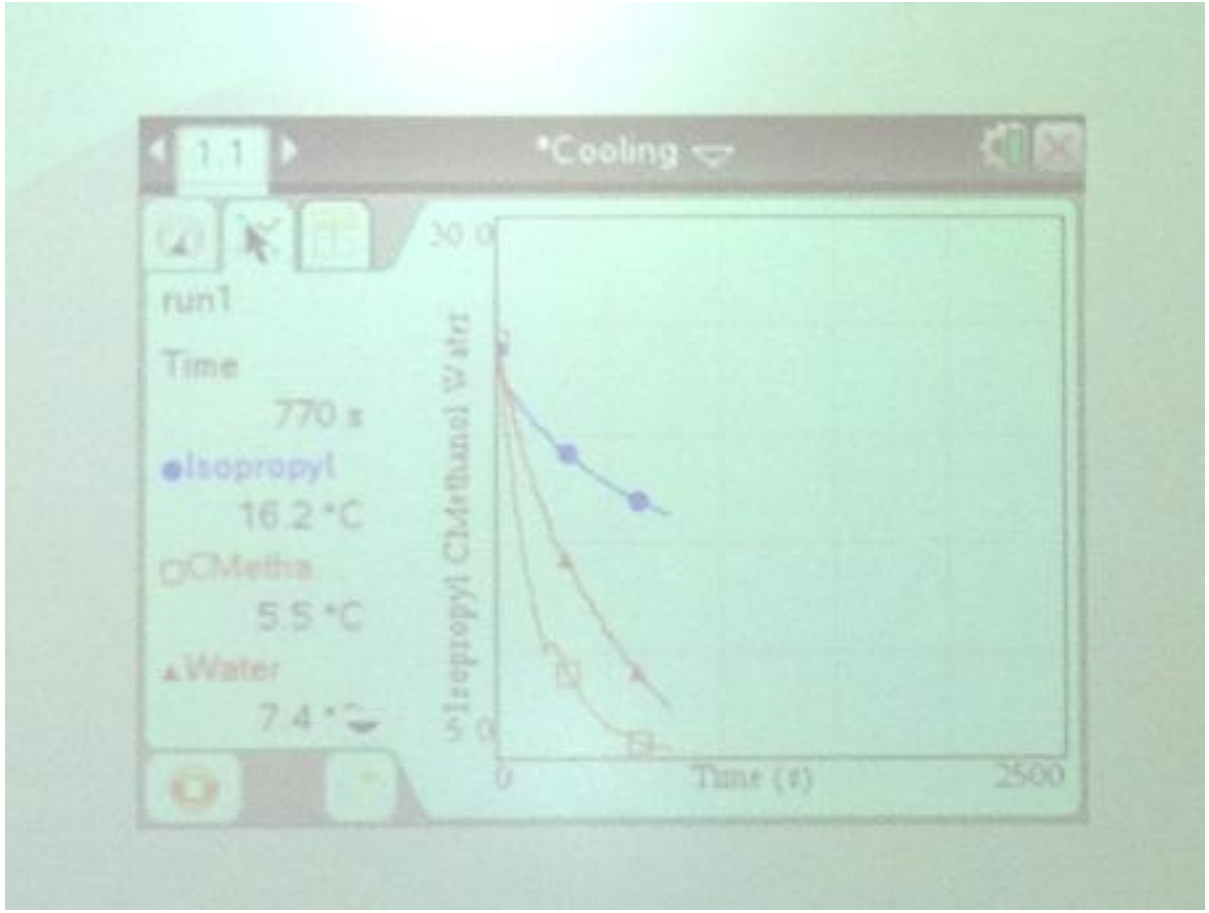
The Process

The Setup With Computer

Progress Reports

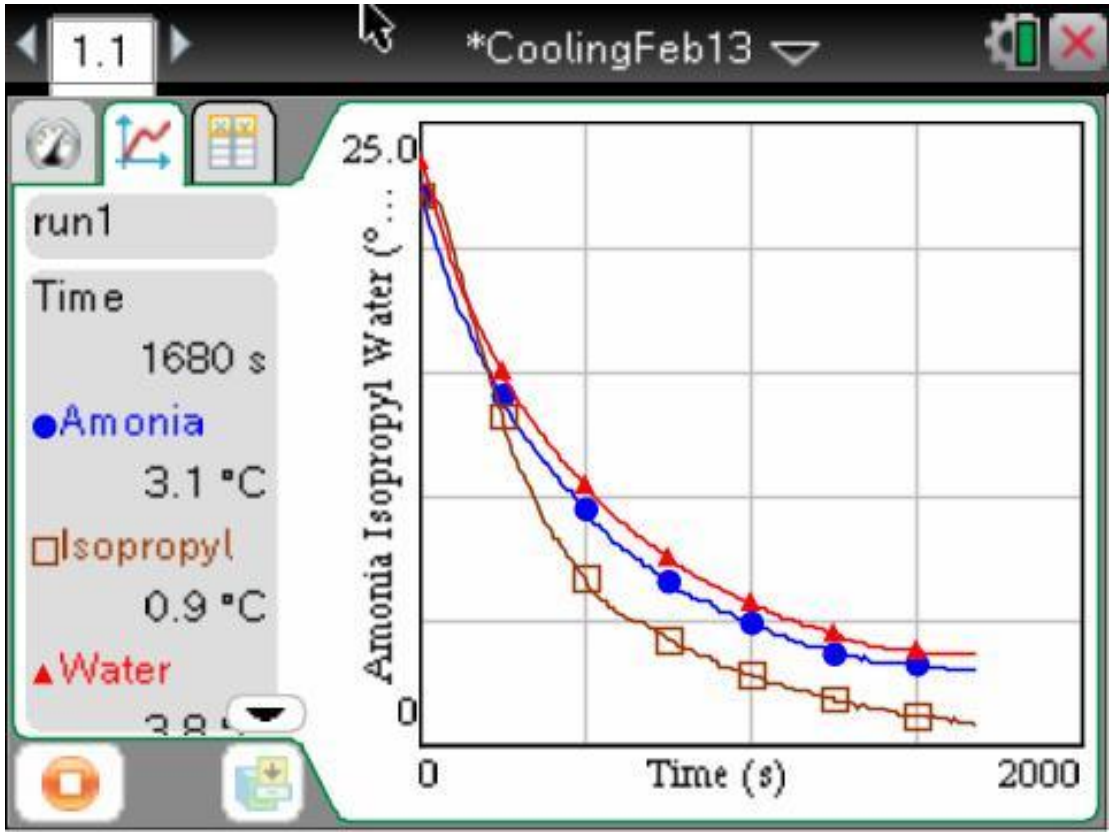


Can Be Viewed By The Class

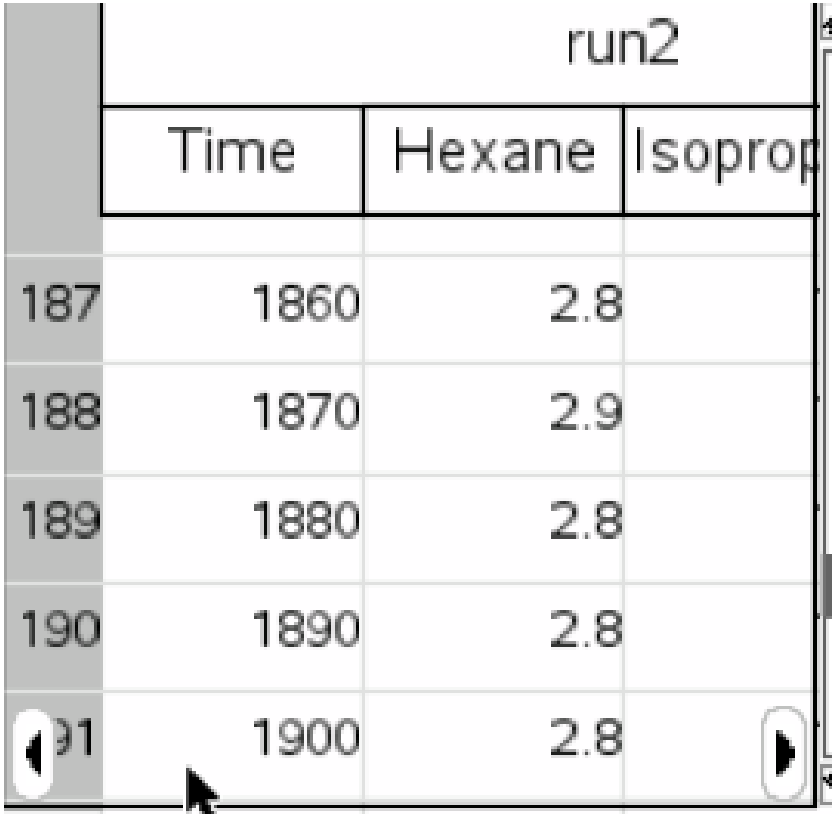


Are Also Available Graphically

In 50 minutes some nice data



And at the end as a spreadsheet



	run2		
	Time	Hexane	Isoprop
187	1860	2.8	
188	1870	2.9	
189	1880	2.8	
190	1890	2.8	
91	1900	2.8	

Post-capture Analysis

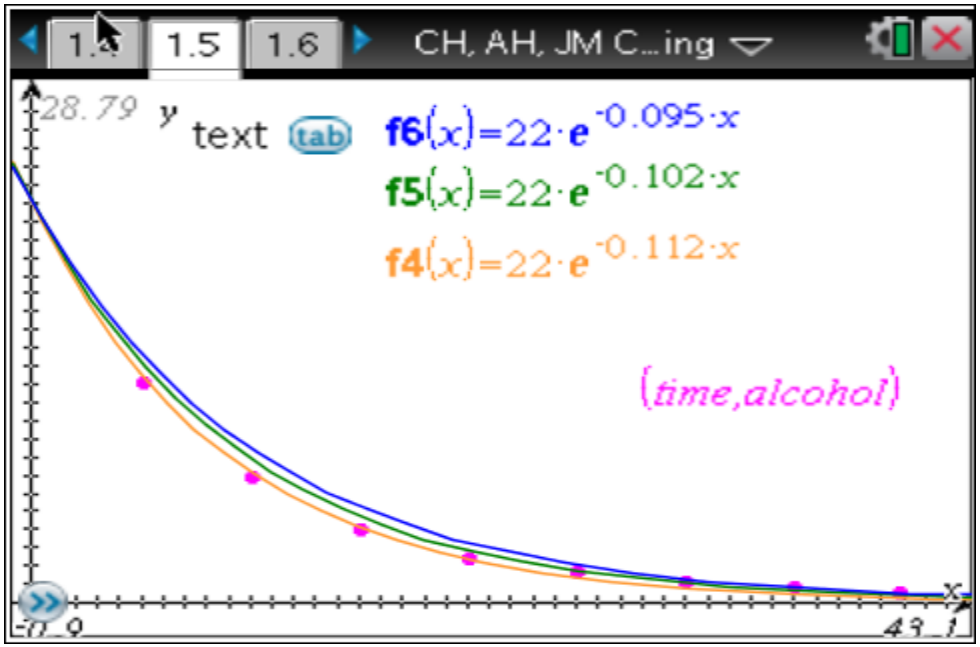
- Discuss in class how this relates to our theoretical discussion of Newton's Law
- Assign groups to different liquids or data points
- Provide an outline of the write-up

Typical Outline Of The Write-Up

- Introduction (this is a writing project, so ask for readability)
- Background and raw data
- Three variations of the DE
  - Three different t_1's
  - Complete derivations, with plots
  - TI's built-in exponential regression
- Discussion

Some Results

All derived equations for tap water appear to be good predictors. This is because, when plotted, each equation generates a curve that most closely tracks the discrete data points. When compared to our raw data table, however, the equation f (1) appears to generate the best cooling constant to predict tap water's temperature at 39.75 minutes. At T(39.75) tap water was at 1.0 ° C minutes



Suggestions

- Change liquids between semesters
- Talk to your chemists
  - Soap – useless
  - Cyclohexane – interesting behavior
- Watch over the students (some writing time in class)

Other Experiments

- Logistic Growth (Bread mold)
- Fluid Flow (Torricelli)
- Parachute vs. gravity

References

http://jckallenbach.weebly.com/differential-equations.html

http://education.ti.com/en/timathnspired/us/home