MPTC Electromagnetism daily calendar (draft)

Day 1	**AM -** Distribute workshop materials, - Pretest - Introduce leaders and participants - Discuss workshop design and course expectations. <u>Begin Unit 1</u> - Do force diagrams of rubbed balloon stuck to wall and ceiling (intr force electric) - Sticky tape activity **PM** - Post-activity (sticky tape) discussion - develop atomic model of matter, charge - conductors and insulators, polarization, - Worksheet 1 and whiteboard - Electrophorus activity **HW** - Reading: Sherwood and Chabay: Begin Chapter 15, Electric Fields and Matter
Day 2	**AM** – Whiteboard electrophorus activity - charging by conduction and induction - Investigating charge with Vernier charge sensor - Do worksheet 2 **PM –** Whiteboard worksheet 2 - Construct and investigate the Leyden jar - Electrostatics quiz **HW –** Reading and reflection: Finish reading Chapter 15, Electric Fields and Matter
Day 3	**AM -** Determine relationship of electric force and distance between charges - pre-lab - perform lab using video and process data - board meeting on lab **PM** - Post lab discussion, look at effect of charge on force, produce Coulomb's Law - Do worksheet 3 and whiteboard it - Do charge on a tape mini-lab **HW –** Work on Coulomb's Law in lab notebook
Day 4	**AM** - Discuss methods used to determine the charge on a piece of sticky tape and the fraction of molecules that gained or lost an electron - Mapping the electric field activity **PM** - *EM Field* exploration activity with PhET simulation, discuss - define electric field using a graph - Do worksheet 4 and whiteboard - Do worksheet 5 and whiteboard **HW –** Read teacher notes on Unit 1, reflections on Unit 1 in notebook

Day 5	**AM** Begin Unit 2 - Stairway activity to introduce potential - define gravitational and electric potential, derivations - do worksheet 1 and whiteboard - Lab: topographic maps and gravitational potential - Discuss key points of topographic (contour) mapping - Lab: Mapping electric potential - collect data, enter into spreadsheet, make graphs **Turn in notebook** **HW – Supplemental worksheet 1**

Week 2

Day 6	**AM** - Review what we've done in the potential unit so far - Discuss manipulating features of charts in Excel 2013 - show different graphs on the projector - Discuss potential mapping lab concepts - Define eV(electron-volt) - Work on worksheet 2 - Whiteboard worksheet 2 - Activity using PhET simulation: Exploring Electric Potential - Discuss Exploring Electric Potential results **PM** - Discuss potential due to a point charge - Work on worksheet 3 - Whiteboard worksheet 3 - Two conducting sphere thought questions - High wire worker clip - Do worksheet 4 and whiteboard - Whiteboard worksheet 4 **HW –** Reading and reflection: Chabay and Sherwood, Matter and Interactions Chapter 19.1-19.7, A Microscopic view of electric circuits (**This is heavy reading!)**
Day 7	**AM** - Demo/discussion on charge, potential for parallel plates - Lab: Determine the relationship of the energy stored in a capacitor and the potential difference across the capacitor - collect and analyze data, discussion of lab - Do lab extension on series and parallel capacitors and discuss - Do worksheet 5 - Whiteboard worksheet 5 - Bridging demo to circuits **PM –** Begin Unit 3. - Lab: What's Happening in the Wires? - Pre-lab discussion - Collect and evaluate data for parts 1 and 2 - Discussion of representations of charge distribution at various times

	- Discuss transient condition and resistance. -Do worksheet 1 - Whiteboard worksheet 1 **HW** – Reading and reflection: Chabay and Sherwood, Matter and Interactions 19.8-19.10, Energy in a circuit
Day 8	**AM** - Do Lab 2: Charge Distribution and Potential Difference - collect and analyze data, post-lab discussion, discuss readings (C/S and surface charge distributions) , discuss flow rate vs. drift velocity, discuss E-field and drift velocity, discuss L and R bulb in series and parallel circuits - Do worksheet 2 - Whiteboard worksheet 2 **PM** - Lab: Determine the relationship of the potential difference and the current for a simple circuit with a constant resistance - Do long bulb extension, collect and w/b data - Whiteboard lab **HW** – Write up Ohm's Law Lab. This is a long form lab. Please word process it and turn it in to Michael on Friday (or earlier). The lab extension is not part of the lab report. Make sure you look at the criteria for a long form lab and perhaps look at the sample 2nd Law lab report.
Day 9	**AM** - Lab: Determine the relationship of resistance and length of resistor and of the resistance and cross sectional area of resistor. - Lab: resistors in series and parallel**,** collect and w/b data, post-lab discussion to develop characteristics of each circuit, resistor addition rules **PM** - Do worksheet 3 and whiteboard - Whiteboard worksheet 3 - Do worksheet 4 and whiteboard - Whiteboard worksheet 4 **HW –** Look over Unit 2 teacher notes and reflect on Unit 2
Day 10	**AM** - Do resistor network addition - Practice sheet - Circuit practicum - Go over DIRECT test, check answers with equipment - Graph current vs. time for large capacitor and long bulb, get charge **Turn in notebook** **Please turn in problem set 1 by noon today, if you contracted for an A.** **HW –** Read and reflect on one of the research papers below MacKenzie R. Stetzer, Paul van Kampen, Peter S. Shaffer, and Lillian C. McDermott: "New insights into student understanding of complete circuits and the conservation of current", *American Journal of Physics* **81**, 134-143 (2013). R. Cohen, B. Eylon, and U. Ganiel, "Potential difference and current in simple electric circuits: a study of students' concepts", Am. J. Phys. **51,** 407-412 (1983).

Week 3

Day 11	**AM** <u>Begin Unit 4</u> - Lab 1: investigation of the magnetic field around a current-carrying wire; collect and whiteboard data, post-lab discussion, RH curl rule - Determine the relationship of magnetic field strength (B) and the distance from the center of a current bearing wire (r), - Relationship of the magnetic field strength (B) and the current in the wire (I) - Whiteboard B field of a wire lab and discuss - Activity/discussion of field around a permanent magnet - Field direction demos for wire and solenoid, rules for magnetic field direction - Do worksheet 1 - Whiteboard worksheet 1 **PM** - "Oh No! Mr. BIL" and force on a wire, rules for force on wire - Demo/discussion: force on charged particle -cathode ray tube demo - use VPython to help deduce equation - Do worksheet 2 - Whiteboard worksheet 2 - VPython and relationships of B and r, v and r, q and r, m and r, T and r **HW –** Reading and reflection: Chabay and Sherwood, Matter and Interactions Chapter 18.9-18.11, Magnetism
Day 12	**AM** - Make current balances - Lab: Magnetic force on current-bearing wire - Relationship of the magnetic force on the wire and the current through the wire - Relationship of the magnetic force on the wire and the length of the wire - Relationship of the magnetic force on the wire and the magnetic field strength - Whiteboard lab and come up with Force on wire equation **PM** - Do worksheet 3 and whiteboard - Whiteboard worksheet 3 - Lorentz force -VPython mass spectrometer activity - Hall effect -Worksheet on Hall effect - Build Johnson motors **HW –** Reading and reflection: Chabay and Sherwood, Matter and Interactions Chapter 21.1 – 21.5, Magnetic Force (21.6 if you enjoy relativity and reference frames)

Day 13	**AM** -Introduction to TIPERS - Do magnetic force TIPERS, Ranking Tasks - Introduce motional EMF - Magnetic flux, Faraday's Law, Lenz's Law - look at demos on Faraday's and Lenz's laws **PM** - Practice with coils and galvanometer - Do worksheet 4 - Whiteboard worksheet 4 **HW** – Reflect on Unit 3 or 4 (due Thursday)
Day 14	**AM** - Do drop the magnet activity - Review electromagnetic induction - Induction demos and thought questions - Do worksheet 5 - Whiteboard worksheet 5 **PM** - Induction TIPERS - Do worksheet 6 - Whiteboard worksheet 6 **HW – Work on 2-page paper if you contracted for "B" or "A" grade** **Turn in notebook**
Day 15	**AM** - Faraday's Law lab (a quantitative treatment of Faraday's Law) - Post-test - Wrap up **Due today: Set 2 of "A" credit problems** **Turn in 2-page paper if you contracted for "B" or "A" grade**