Model: Fields, Forces, Potential & Potential Energy

Act 9.2.4 Measuring Electric Potential (Voltage) Changes *Inside* a Resistor 70 min

Learning Goals:

- Understand the analogies between gravitational fields and electric fields
- Understand the electric potential (voltage) that exists around an electric charge
- Understand how electric potential relates to the electric field.
- Understand the field and voltage pattern within the plates of a capacitor
- Recognize that energy conservation holds regardless of the orientation or strength of the electrical fields present, or the sign or magnitude of the participating electrical charges
- Understand the relationship between an electric field E and its electric potential V

Model: Magnetic Fields & Forces

Act 9.3.1 Magnetic Dipole Fields, including FNT 2 [9.3-1], and their energies 60 min

Learning Goals:

- Determine and become familiar with the field directions for a permanent magnet
- Understand how magnetic field vectors add to give a total magnetic field
- Understand that a permanent magnetic dipole can induce a dipole in certain magnetic substances, just as electric dipoles can induce dipoles in substances that can be polarized
- Use energy relationships to make sense of how dipoles align.

9.3-2 (Review/Application) Explain in your own words using an energy argument (that a **Phy 7A** (not 7C) student would understand) why a compass points parallel to the direction of the magnetic field that exists in that space. You will have to write down and briefly explain any constructs and relationships you use in your explanation. Remember, Phy 7A students are good at using energy arguments, but know nothing about magnetism.

9.3-3 (Application) Think about the expression for the potential energy of a magnetic dipole in the field due to another magnetic dipole, that is fixed in space. (a) What spatial arrangement of these two dipoles produces the lowest value of the PE of the movable dipole? (b) What spatial arrangement produces the highest PE of the movable dipole? (c) What spatial arrangement produces a PE of zero? You can think of the dipoles as little permanent magnets, like the ones you were given. Sketch the locations of the dipoles for each of the three arrangements and explain how the expression for the energy of a dipole in a magnetic field is consistent with your arrangement.