Election Day

There is a lot going on today.
Please don’t worry about missing class today
if there are other things you should be doing.
We are happy to work with you to make up for any missed time.

Final Projects

Last regular seminar today. **Choice of projects** for rest of semester.

November 3: Motors and Generators (today)
November 10: Final Projects Session 1
November 17: Final Projects Session 2
November 24: Thanksgiving Vacation (no class)
December 1: Final Project Presentations

**Possible Projects**: individual or with a partner
- test a different motor (e.g., 6 coils with 4 permanent magnets)
- characterize and/or improve an electrical generator
- make a new or improved electronic game

**Presentations**: nothing fancy, just tell us what you found
- three minute presentation
- can include a few Powerpoint slides
- can include videos

Coils and Magnets

In both the clanker and motor projects, we used coils of wire as **electrically-controlled magnets**.

The magnetic field produced by the coil is similar to that produced by a permanent magnet.
Coils and Magnets
The field can attract an adjacent magnet.

![Diagram of Teensy 3.2 board with Hall-effect sensors, coil A, and resistors connections.]

Coils and Magnets
Reversing electrical excitation on the coil reverses magnetic force – repelling the same nearby magnet.

![Diagram of Teensy 3.2 board with Hall-effect sensors, coil A, and resistors connections, showing the reversed polarity.]

Electromagnets
We have used a coil as an electrically-controlled magnet to generate force to levitate a clanker or rotate a motor.

![Diagram showing a coil with a current I attracting and repelling magnets.]

Coils and Magnets
Today we will look at the reciprocal principle: moving a permanent magnet can induce a voltage in a nearby coil.

![Diagram showing a coil with a magnetic field change inducing a voltage V.]

Faraday’s Law
When moving a magnet changes the magnetic field through a coil, this motion will induce a voltage $V$ that is proportional to the time derivative of the magnetic field $B$ through the coil.

![Diagram showing a magnet with a coil and voltage induced by a magnetic field change.]

Today’s Project: Build an Electric Generator
Use last week’s motor to generate electricity.

![Diagram of a motor with a generator coil and Hall-effect sensors.]

Add a generator coil to last week’s motor. Use current from the generator coil to light an LED.