CHAPTER 7

Understanding by Design*

The *Understanding by Design* template focuses on the three stages of backward design:

- **Identify desired results**
- **Determine acceptable evidence**
- **Plan learning experiences**

What overarching (enduring) understandings are desired?

Motors and generators are technologies based on the same basic principles of electricity and magnetism.

- The force between two magnets can be described by the interaction of magnetic fields.
- An electric current produces a magnetic field.
- A current-carrying wire in an external magnetic field experiences a force. This force is the basis of an electric motor.
- A current can be created by moving a wire in an external magnetic field. This is the basis for an electric generator.
- Alternating and direct currents can both be generated and used to drive electric motors.
- The symmetry between electric and magnetic fields caused Maxwell to hypothesize that light is an electromagnetic field.

What are the overarching "essential" questions?

- What is a magnetic field? How does this model help explain "action at a distance?"
- What evidence exists that electric currents create magnetic fields?
- How can you build a motor?
- How can you create an electric current?
- How is an electric generator constructed?
- Why do some generators produce DC and others produce AC?
- What is the relationship among electricity, magnetism and light?
- What is the electromagnetic spectrum?

What will students understand as a result of this chapter?

- The magnetic field can be detected with a compass.
- The magnetic field lines point away from the north pole of a bar magnet and toward the south pole of the magnet.
- A current-carrying wire has a magnetic field that forms circles around the wire.
- A current-carrying wire wrapped around a hollow cylinder will become an electromagnet. If an iron core is placed inside the cylinder, the strength of the magnetic field increases dramatically.
- An electric motor converts electrical energy into mechanical energy. A motor has a current-carrying wire that moves because the magnetic field of the current-carrying wire interacts with the external magnetic field.
- A galvanometer detects small currents by having those currents either move a wire or deflect a compass needle.
- A current will be induced in a wire if it moves past a magnetic field in such a way that the wire "cuts through" the magnetic field lines.
- AC and DC generators produce electricity by moving wires past magnetic fields. AC generators use slip rings and DC motors use split-ring commutators.
- Oscillating electromagnetic fields would travel at the same speed that light travels was the first evidence of electromagnetic waves and the electromagnetic spectrum.
- The electromagnetic spectrum includes light, infrared, microwaves, ultraviolet, radio, X-rays and gamma rays.

What "essential" questions will focus this chapter?

- How do you draw the magnetic field of a bar magnet?
- What is the shape of the magnetic field of a current-carrying wire?
- How do you build an electromagnet?
- What are the necessary components for building an electric motor?
- How does a galvanometer detect current?
- How can you use a magnet to create (induce) a current in a wire?
- How can you make a generator switch from producing AC to DC?
- What evidence exists that light is an electromagnetic wave?
- How can you measure the speed of light?
- What is the electromagnetic spectrum?

* Grant Wiggins and Jay McTighe, *Understanding by Design* (Merrill/Prentice Hall, 1998), 181.