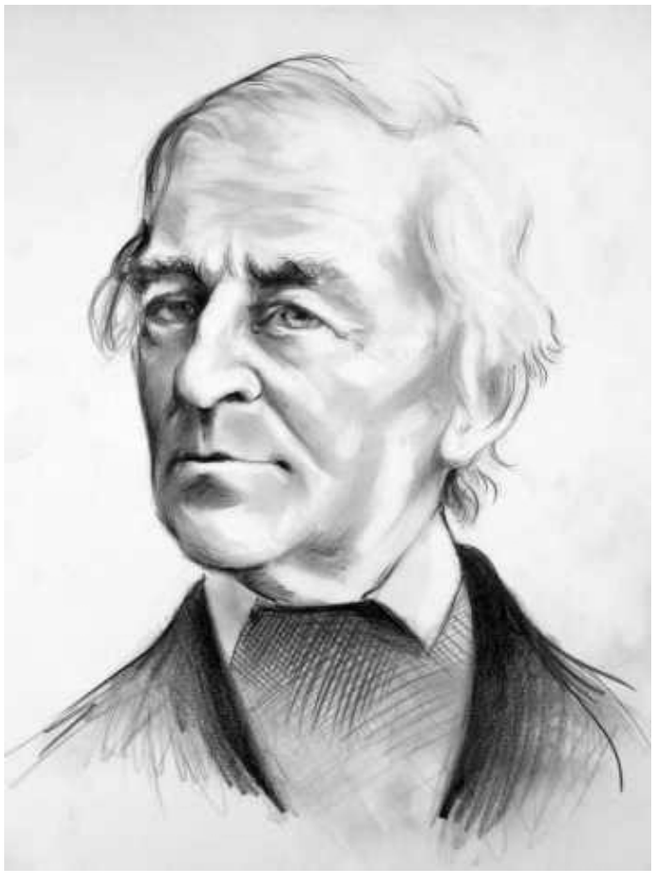
Wisdom is like electricity. There is no permanently wise man, but men capable of wisdom, who, being put into certain company, or other favorable conditions, become wise for a short time, as glasses rubbed acquire electric power for a while.

Ralph Waldo Emerson



Arizona State University
SES 194

Energy in Everyday Life

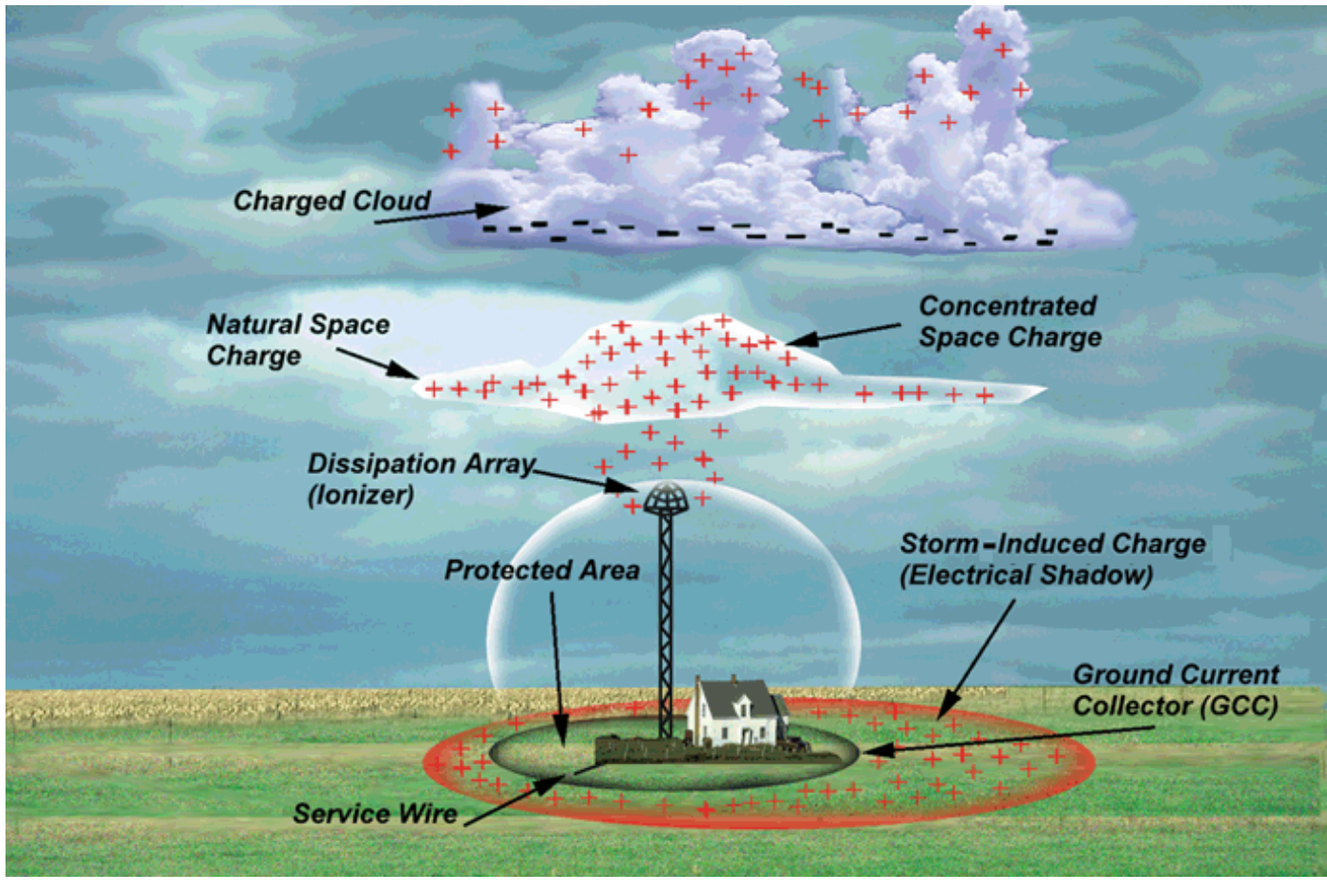
Voltage and Current

Frank Timmes

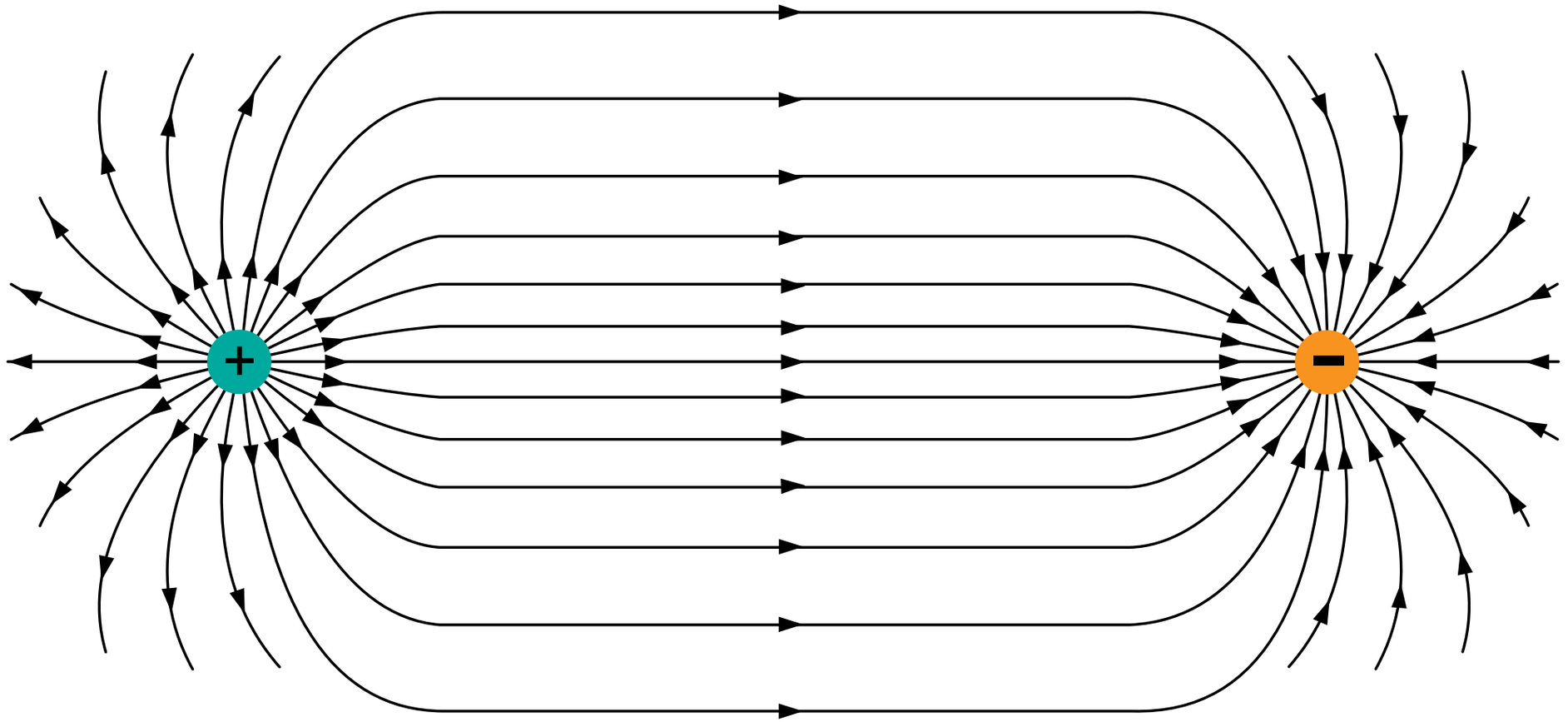
ftimmes@asu.edu

Most everyday materials charge neutral, made up of atoms in which the positive charges balance the negative charges.

But it is possible to separate charges, provided we are willing to do the work to cause the separation.



We may recover the work we did by letting the charges come back together.



The energy is higher when the charges are separated, because we had to do work to separate them, so we can say the two charges have electric potential energy between them.

Like any other form of energy, the electric potential energy is measured in joules.

In everyday applications, it is convenient to use the electric potential energy per unit charge between two points in space.

$$\mathrm{V} = \text{potential} = \frac{\text{electrical potential energy}}{\text{charge}} = \text{electric field} \times \text{distance}$$

The unit of electric potential is the volt, V, named for Alessandro Volt in honor of his pioneering electrical experiments in the 18th and 19th centuries.

One volt is the potential difference between two points necessary to change the energy of 1 C of charge by 1 J in moving between the two points. 1 V = 1 J/C.

Because the unit is the volt, it is common practice to refer to the electric potential as “voltage”.

Voltage

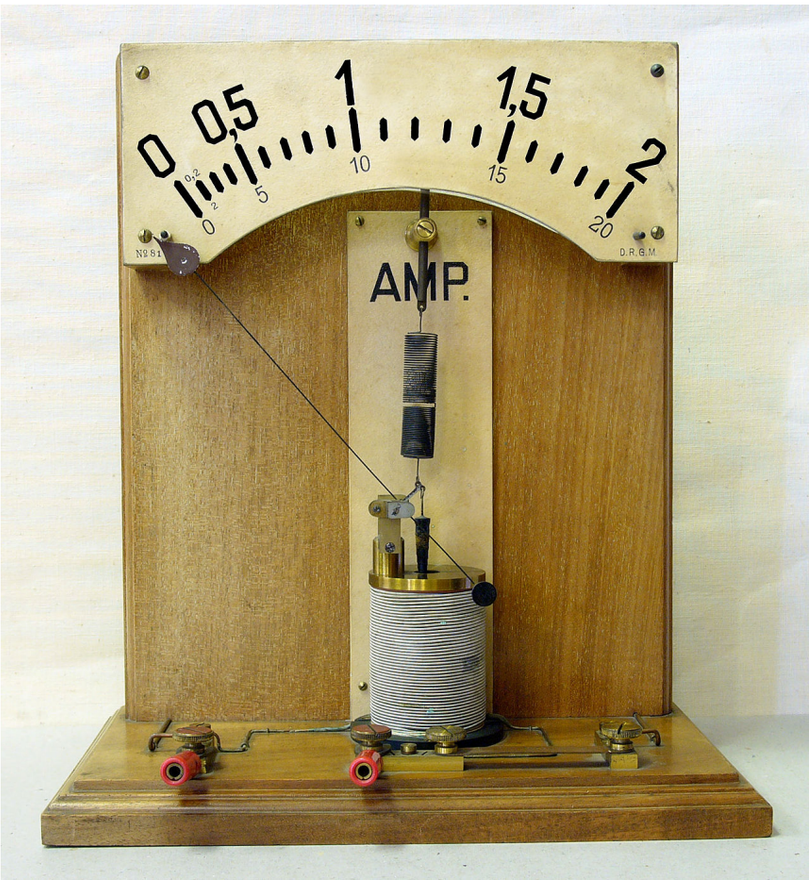
So far our charges have been static, not moving.
Now we'll begin to let our charges move in time.

A moving charge is called a current.

A current of one coulomb per second is called an ampere, in recognition of Andre Ampere's contributions to the interconnection between electricity and magnetism.

$$1 \text{ ampere} = 1 \text{ coulomb per second} \quad (1\ \text{A} = 1\text{C/s})$$

It is common practice to refer to a quantity of current in "amp" or "amps".



In applications of electricity involving metals, it is electrons that flow.

This isn't true for other conductors. For example, in salt water, fluorescent bulbs, and battery acid, atoms with a net positive or negative charge can flow as an electric current.

In fuel cell membranes, the electric current is a flow of positive hydrogen ions, also called protons.