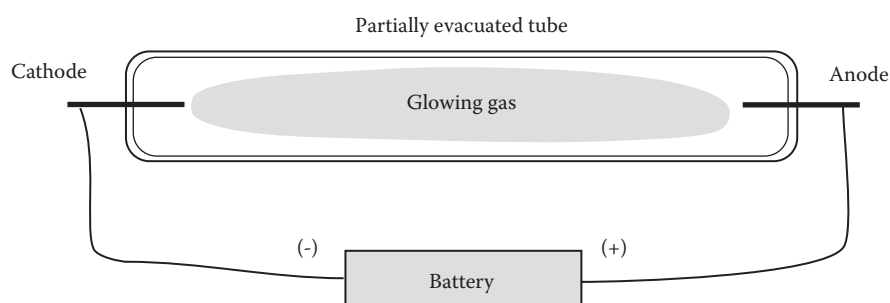


**IN-DEPTH LOOK 5.2: THE DISCOVERY OF THE ELECTRON**

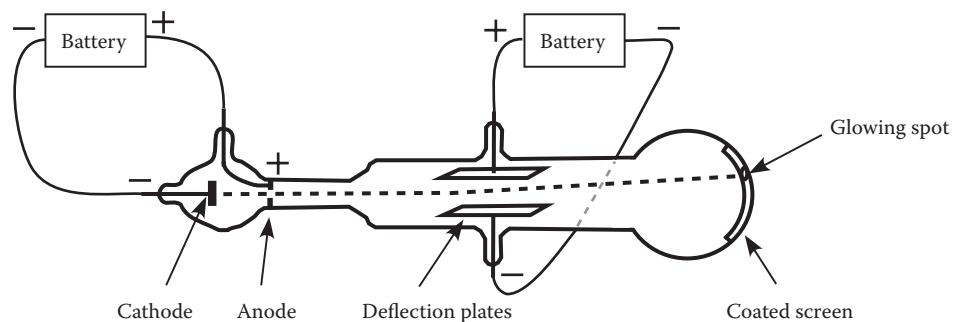
How was the electron discovered? In the 1850s through the 1890s, several German and British physicists were studying a peculiar phenomenon—a glowing gas in a glass tube containing a low-pressure atmosphere. A glass tube, with two metal wires inserted through the walls, was partially evacuated of air. When the two wires were hooked to opposite sides of a **battery**, as illustrated in **Figure 5.4**, a glow was observed in the low-pressure air between the wires. This was the precursor of the modern-day fluorescent light bulb, but at that time, scientists did not know what caused the glow. They suspected that some kind of “rays” were emitted by the cathode, and they called these cathode rays. They did not know what the rays consisted of.



**FIGURE 5.4** Experiment used in the nineteenth century to study electrically excited air.

In 1897, J. J. Thomson, a physics professor at Cambridge University in England, constructed a different design of tube, illustrated in **Figure 5.5**. He reasoned that if the cathode rays were charged particles, they should be susceptible to electric forces. To test this hypothesis, he added a second region to the tube where the rays would pass between two metal plates that were connected to a second battery. A battery charged the cathode negatively, creating the cathode rays, which were attracted toward the positively charged anode. With this design, the rays that were generated by the cathode could pass through a small hole in the anode and continue on, passing between the metal deflection plates. When the rays struck the far right end of the tube, which was coated on the inside with a special material called a phosphor, the material glowed at a small spot. Thomson found that when he applied a battery to the deflection plates, the position of the glowing spot moved. He made careful measurements of the deflection of the rays for various combinations of batteries.

Thomson said, “I can see no escape from the conclusion that [cathode rays] are charges of negative electricity carried by particles of matter.” He also inferred that the particles were about 1,000 times lighter than a hydrogen atom and were basic constituents of atoms. Thomson was awarded the Nobel Prize in Physics in 1906 for these discoveries. Thomson’s cathode ray tube (CRT) is the precursor of the television or TV tube and the computer monitor. These are discussed in Chapter 3 in Real-World Example 3.2. Remarkably, Thomson discovered the electron and invented the TV tube at the same time!



**FIGURE 5.5** Experimental apparatus used by J.J. Thomson for discovering electrons.