

Benjamin Franklin (1706–1790) named the two different kinds of charge *positive* and *negative*. By convention, when you rub a balloon across your hair, the charge on your hair is referred to as *positive* and that on the balloon is referred to as *negative*, as shown in **Figure 2**. Positive and negative charges are said to be *opposite* because an object with an equal amount of positive and negative charge has no net charge.

Electrostatic spray painting utilizes the principle of attraction between unlike charges. Paint droplets are given a negative charge, and the object to be painted is given a positive charge. In ordinary spray painting, many paint droplets drift past the object being painted. But in electrostatic spray painting, the negatively charged paint droplets are attracted to the positively charged target object, so more of the paint droplets hit the object being painted and less paint is wasted.

Electric charge is conserved

When you rub a balloon across your hair, how do the balloon and your hair become electrically charged? To answer this question, you'll need to know a little about the atoms that make up the matter around you. Every atom contains even smaller particles. Positively charged particles, called *protons*, and uncharged particles, called *neutrons*, are located in the center of the atom, called the *nucleus*. Negatively charged particles, known as *electrons*, are located outside the nucleus and move around it. (You will study the structure of the atom and the particles within the atom in greater detail in later chapters on atomic and subatomic physics in this book.)

Protons and neutrons are relatively fixed in the nucleus of the atom, but electrons are easily transferred from one atom to another. When the electrons in an atom are balanced by an equal number of protons, the atom has no net charge. If an electron is transferred from one neutral atom to another, the second atom gains a negative charge and the first atom loses a negative charge, thereby becoming positive. Atoms that are positively or negatively charged are called *ions*.

Both a balloon and your hair contain a very large number of neutral atoms. Charge has a natural tendency to be transferred between unlike materials. Rubbing the two materials together serves to increase the area of contact and thus enhance the charge-transfer process. When a balloon is rubbed against your hair, some of your hair's electrons are transferred to the balloon. Thus, the balloon gains a certain amount of negative charge while your hair loses an equal amount of negative charge and hence is left with a positive charge. In this and similar experiments, only a small portion of the total available charge is transferred from one object to another.

The positive charge on your hair is equal in magnitude to the negative charge on the balloon. Electric charge is conserved in this process; no charge is created or destroyed. This principle of conservation of charge is one of the fundamental laws of nature.

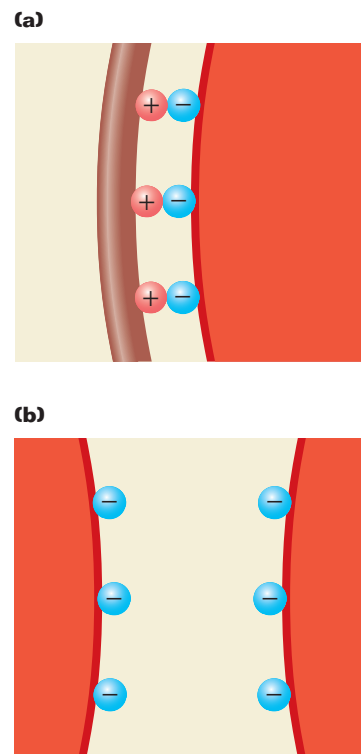


Figure 2

(a) This negatively charged balloon is attracted to positively charged hair because the two have opposite charges. **(b)** Two negatively charged balloons repel one another because they have the same charge.

Did you know?

Some cosmetic products contain an organic compound called *chitin*, which is found in crabs and lobsters, and in butterflies and other insects. Chitin is positively charged, so it helps cosmetic products stick to human hair and skin, which are usually slightly negatively charged.