▶ Video explanation (YouTube Short)

Conductors, Insulators and Earthing

Rub a plastic comb on dry hair and it picks up bits of paper. Rub a steel spoon held in your hand and nothing happens. Rubbing moves electrons from one object to another; an object with extra or missing electrons is **charged**. What happens to that charge next depends on the material (NCERT 1.3).

Conductors vs insulators

	Conductors	Insulators
Electrons	free electrons, about one per copper atom (≈ 8.5×10^{28} per m³)	bound to their atoms
Charge given to it	spreads over the whole surface	stays where it was put
Held in the hand and rubbed	charge leaks through the body to the earth	stays charged
Resistivity	copper ≈ 1.7×10^{-8} Ω·m	glass ≥ 10^{10} Ω·m (≈ 10^{18} times copper)
Examples	metals, human body, earth, salt water	plastic, glass, nylon, wood, rubber, porcelain

Semiconductors (such as silicon, ≈ 10^{3} Ω·m) lie between the two.

Why the spoon fails. Spoon, hand and body are all conductors, so the spoon's charge flows through you into the earth. Hold a metal rod by a plastic handle and rub it: the charge has no path to the earth, and the rod picks up paper too.

Earthing (grounding)

Connecting a charged body to the earth lets its extra charge flow away in a brief current. The earth is so large (capacitance $4\pi\varepsilon_0 R \approx 7 \times 10^{-4}$ F) that adding or removing charge hardly changes it: a **giant charge reservoir**, like a bucket of water poured into the ocean, which leaves the level unchanged.

At home: a thick metal plate is buried deep in the ground; the earth wire from it goes to the metal bodies of appliances such as an iron or a fridge (the third pin of the plug). If the live wire touches the body, the current flows through the earth wire instead of through you, and the fuse blows. **Fuel tankers** are earthed before refuelling so static charge cannot cause a spark.

Common mistakes

- ✗ "Metals cannot be charged." ✓ They can, if insulated from the earth.
- ✗ "The human body is an insulator." ✓ It is a conductor.
- ✗ "Charge on an insulator spreads out." ✓ It stays where it was put.

Practice questions

1. (MCQ) Which is a conductor? (a) glass (b) nylon (c) human body (d) porcelain
2. (MCQ) Copper has about how many free electrons per atom? (a) 0 (b) 1 (c) 10 (d) 29
3. (MCQ) The earth wire of an appliance is joined to (a) the live wire (b) the neutral wire (c) its metal body (d) the switch
4. (Very short) Define earthing.
5. (Short) Why does a plastic comb get charged on combing dry hair but a hand-held steel spoon does not?
6. (Short) How can a metal rod be charged by rubbing?
7. (Short) Why are fuel tankers earthed before refuelling?
8. (Numerical) By how many orders of magnitude does the resistivity of glass (10^{10} Ω·m) exceed copper's (1.7×10^{-8} Ω·m)?
9. (HOTS) A charged metal ball hangs from a nylon thread; another is joined to the ground by a copper wire. Which keeps its charge?

Answer key

1. (c) human body.
2. (b) about 1.
3. (c) its metal body.
4. Connecting a charged body to the earth so its extra charge flows away (sharing charge with the earth).
5. Plastic is an insulator, so the charge stays; the spoon's charge flows through the hand and body to the earth.
6. Hold it by an insulating (plastic) handle.
7. To drain static charge so no spark ignites the fuel vapour.
8. $10^{10} / 1.7 \times 10^{-8} \approx 6 \times 10^{17}$: about 18.
9. The ball on the nylon thread (nylon is an insulator); the other is earthed and loses its charge.

▶ Watch the video explanation