Electrostatic explanations: electrons and polarisation

Student activity • observation and reasoning

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The question

How can a charged rod attract an object with no net charge?

Combine a paper-attraction observation with particle diagrams and a staff electroscope demonstration.

Equipment

- Polythene rod, dry cloth, paper pieces and booklet
- Staff electroscope with intact protective case

Use smooth rods away from faces and electronics. Do not open or touch the fragile electroscope leaf. Staff handle and discharge the apparatus according to its instructions. No balloons, high-voltage supplies or water streams are used.

Course coverage: Physics only: 2.24P–2.26P. Electron transfer and electrostatic effects.

Plan, model or apparatus sketch

Draw a labelled setup or force diagram; include the measured quantities.

Method and reasoning

Read the whole sequence before starting

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1. Use a dry polythene rod and cloth to repeat the paper-attraction observation. Keep a control trial with the unrubbed rod.

2. Draw a before-and-after charge diagram for rubbing. For the stated model where the rod gains electrons, show the cloth losing the same number.

3. Draw a neutral paper piece with its charges slightly redistributed by the nearby rod. Keep its total charge zero.

4. Observe staff bringing the charged rod near an initially discharged electroscope cap without touching. Record the leaf movement as the rod approaches and is removed.

5. Distinguish temporary charge redistribution from charging by contact. Do not assume leaf divergence identifies positive or negative charge.

6. Explain the observations using electron movement and electric forces. State where the simplified particle diagrams omit the detailed structure of the material.

Cleanup

- Collect paper pieces and store the discharged electroscope safely.

Record your evidence

Blank spaces are for your own work

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Reference and task data

The negative-rod example is an explicitly stated model, not a sign measurement. In a neutral electroscope, a nearby charged rod redistributes charge; removal should reverse the effect if no charge was transferred. Paper is polarised without requiring free electrons to travel through it as in a metal.

Situation	Observed movement	Electron / charge explanation
Unrubbed rod near paper		
Rubbed rod near paper		
Rod near electroscope		
Rod removed		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. How does an object become negatively charged?

2. How does it become positively charged?

3. Are protons rubbed from one rod to another?

4. Why can neutral paper be attracted?

5. Does electroscope leaf divergence give the sign?

6. What distinguishes induction without contact from charging by contact?