

THE STANDARD

Noncontact Forces

Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.



PS2.B · Types of Interactions

Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively).

Some forces work without contact. A magnet pulls a paperclip across a gap. A charged balloon tugs a stream of water without touching it. Earth pulls a dropped pencil to the floor. The explanation isn't magic. It's a field. A field is a region around an object where another object can feel a force. **The space isn't empty.**



Planning and Carrying Out Investigations

Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation.

Students aren't just watching a demo. They're running an investigation and then turning around and critiquing how it was set up. Did the procedure actually produce evidence a field exists? Were the variables controlled? Would a skeptical classmate buy the data? Running the experiment is half the work. **Evaluating the design is the other half.**



Cause and Effect

Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Fields cause forces. That's the whole cause-and-effect chain. A magnetic field is the cause. A paperclip jumping toward the magnet is the effect. Students use that pattern to predict what will happen when the field is stronger, when distance increases, or when something blocks the path. **If they can predict, they understand the cause.**