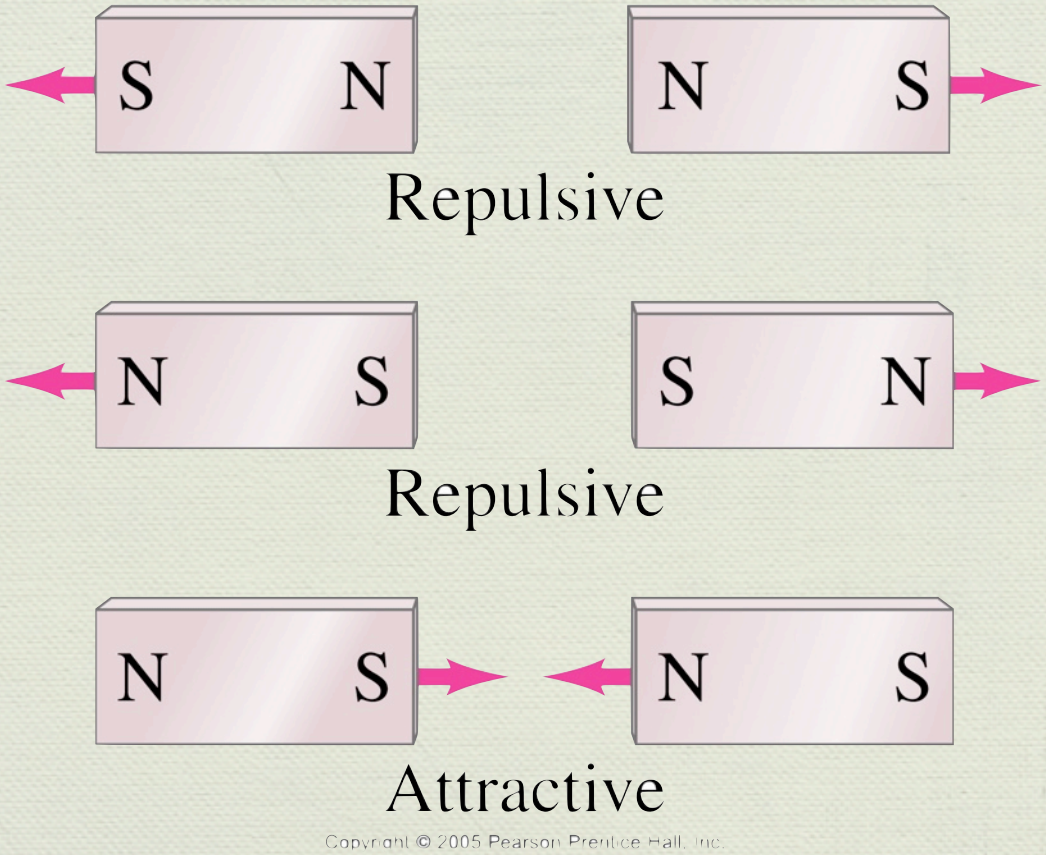
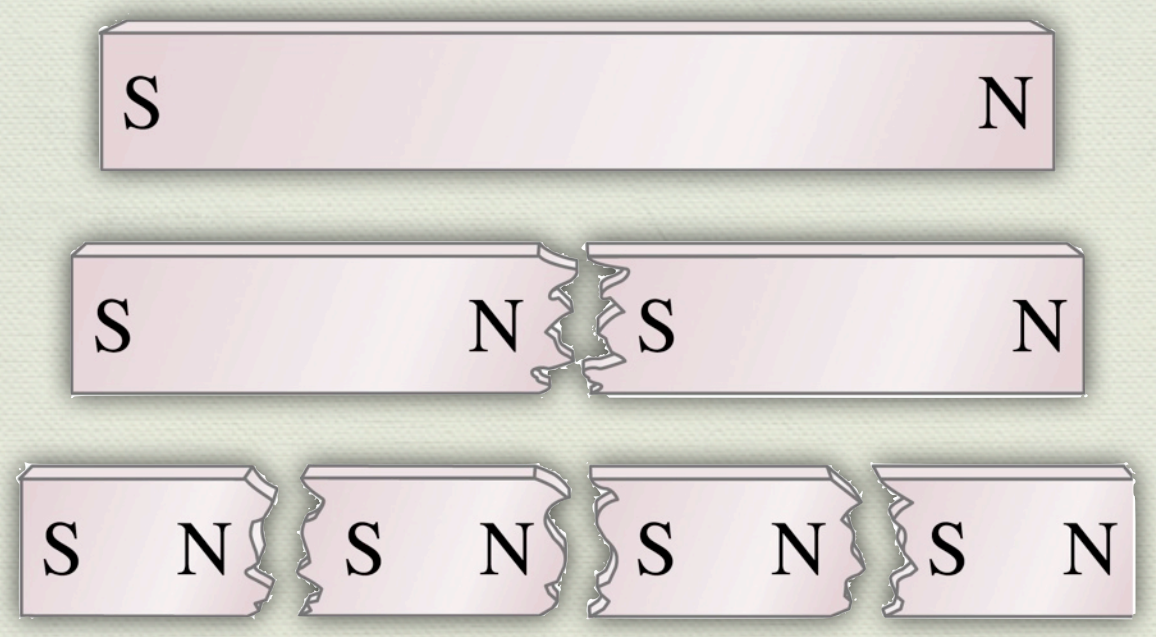
Magnetism
Day 1
Right Hand Rules

Magnetic Fields

- Magnets have two ends – poles – called north and south.
- Like poles repel; unlike poles attract.



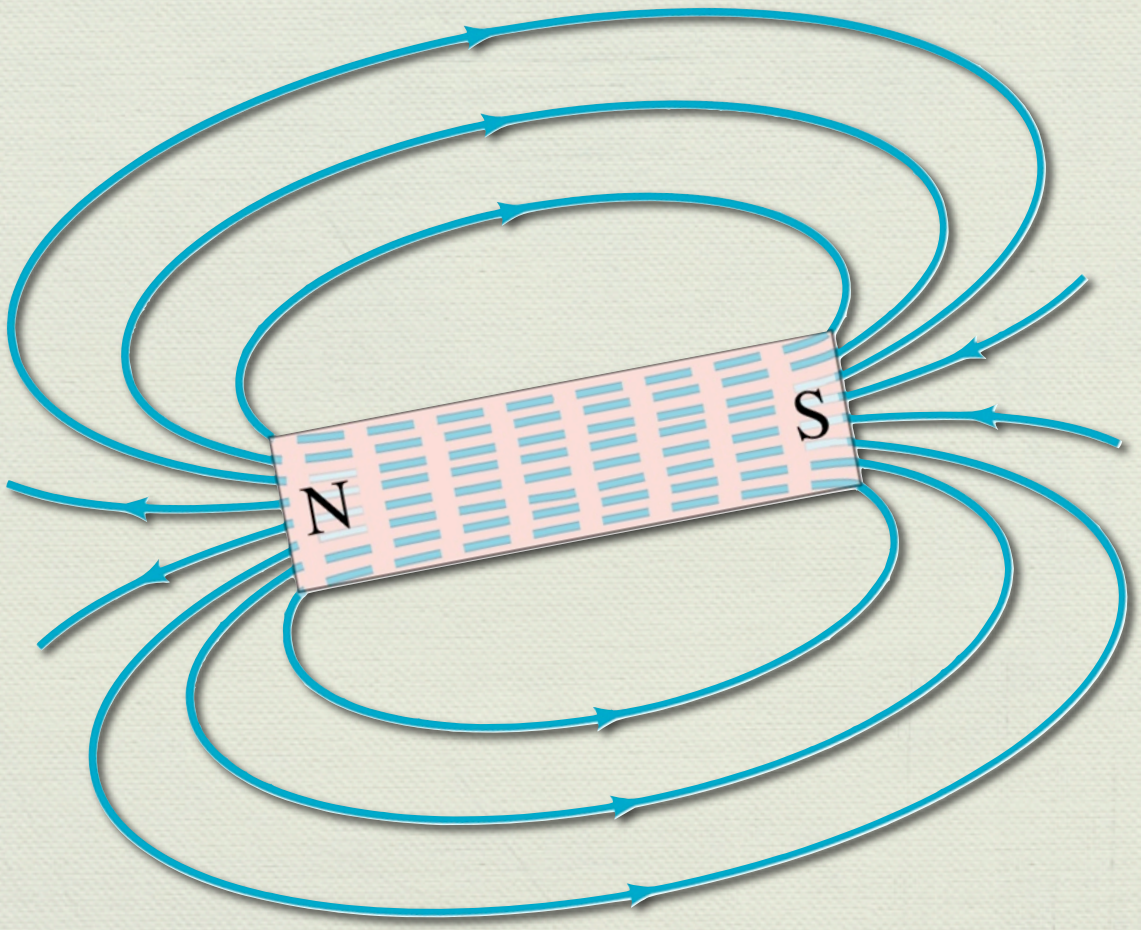
Magnetic Fields



- However, if you cut a magnet in half, you don't get a north pole and a south pole – you get two smaller magnets.

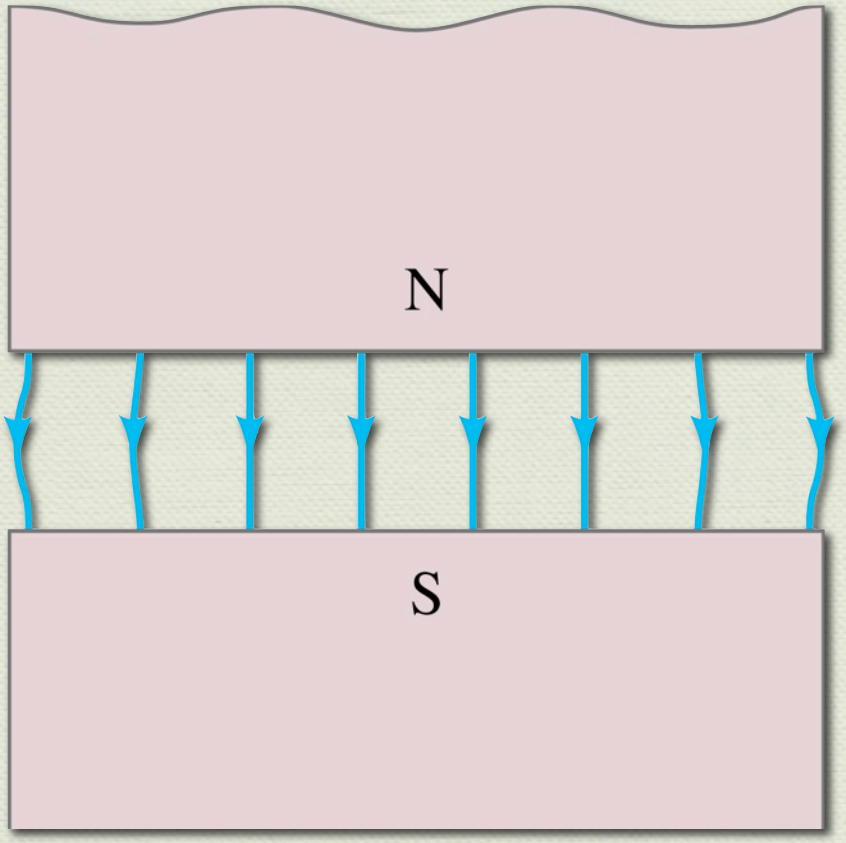
Magnetic Fields

- Magnetic fields can be visualized using magnetic field lines, which are always closed loops.



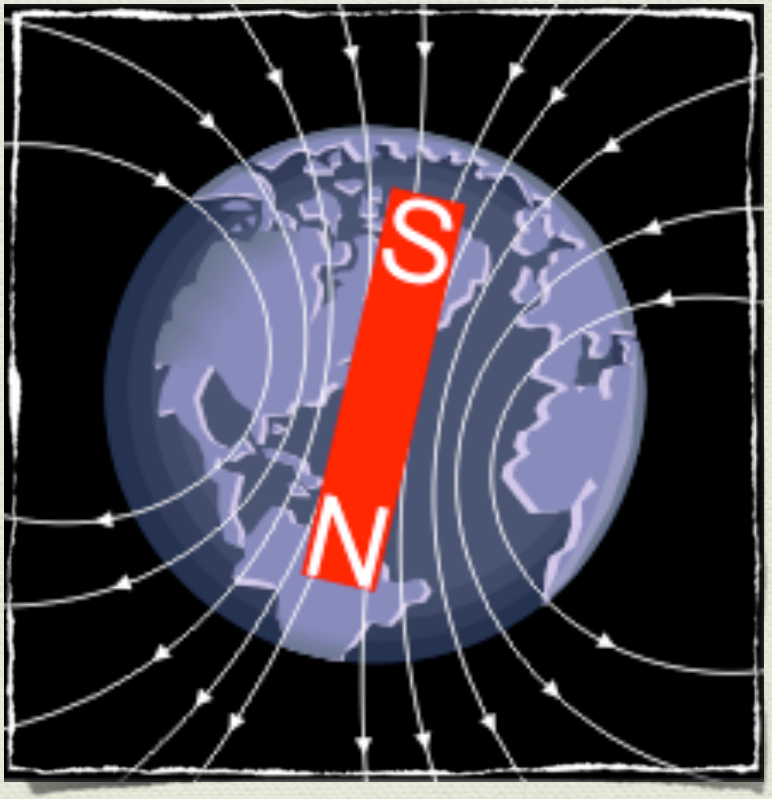
Magnetic Fields

- A uniform magnetic field is constant in magnitude and direction.
- The field between these two wide poles is nearly uniform.



Which end is up?

- The Earth's magnetic field is similar to that of a bar magnet.
- Note that the Earth's "North Pole" is really a south magnetic pole, as the north ends of magnets are attracted to it.



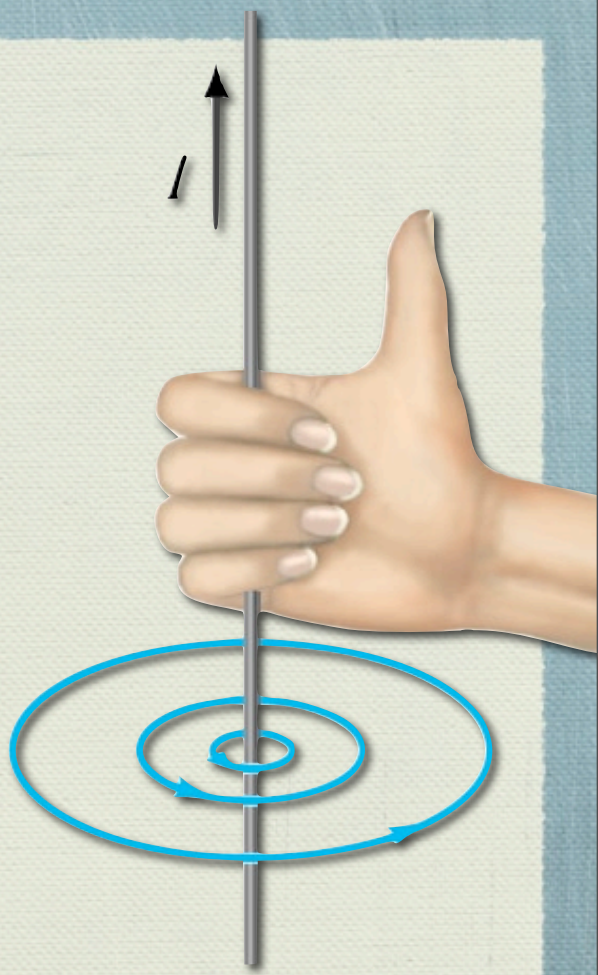
$(3.1\times10^{-5}\ \mathrm{T})$
Strength of Earth's magnetic field at 0° latitude

Hans Christian Oersted

- Observed that a current in a wire would deflect the needle of a compass

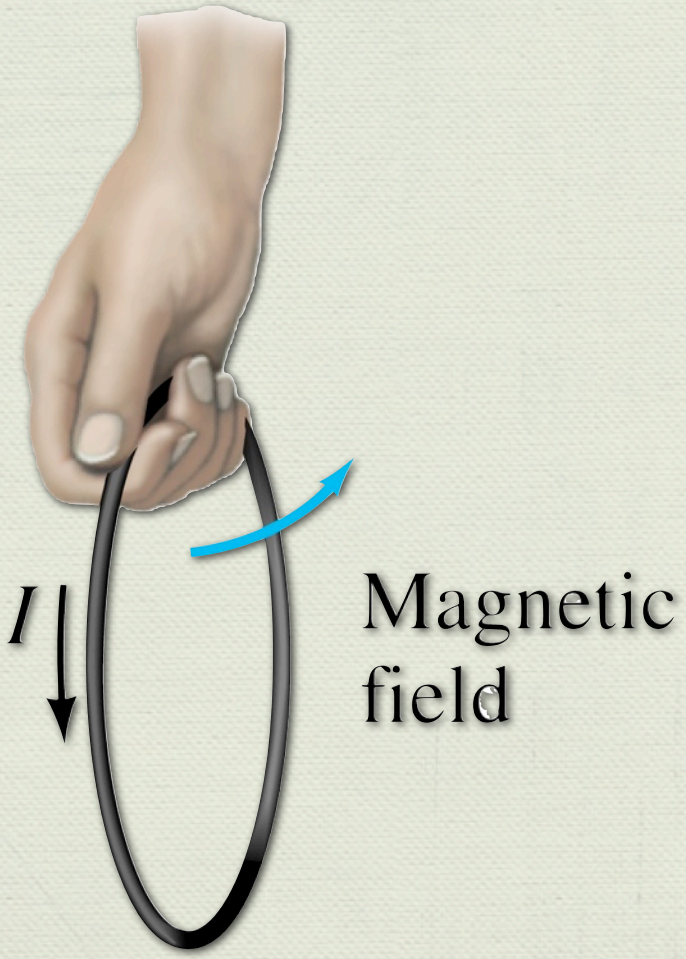
Right Hand Rule

- A circular magnetic field is created by a current in a wire. Fingers on your right hand point from North to South

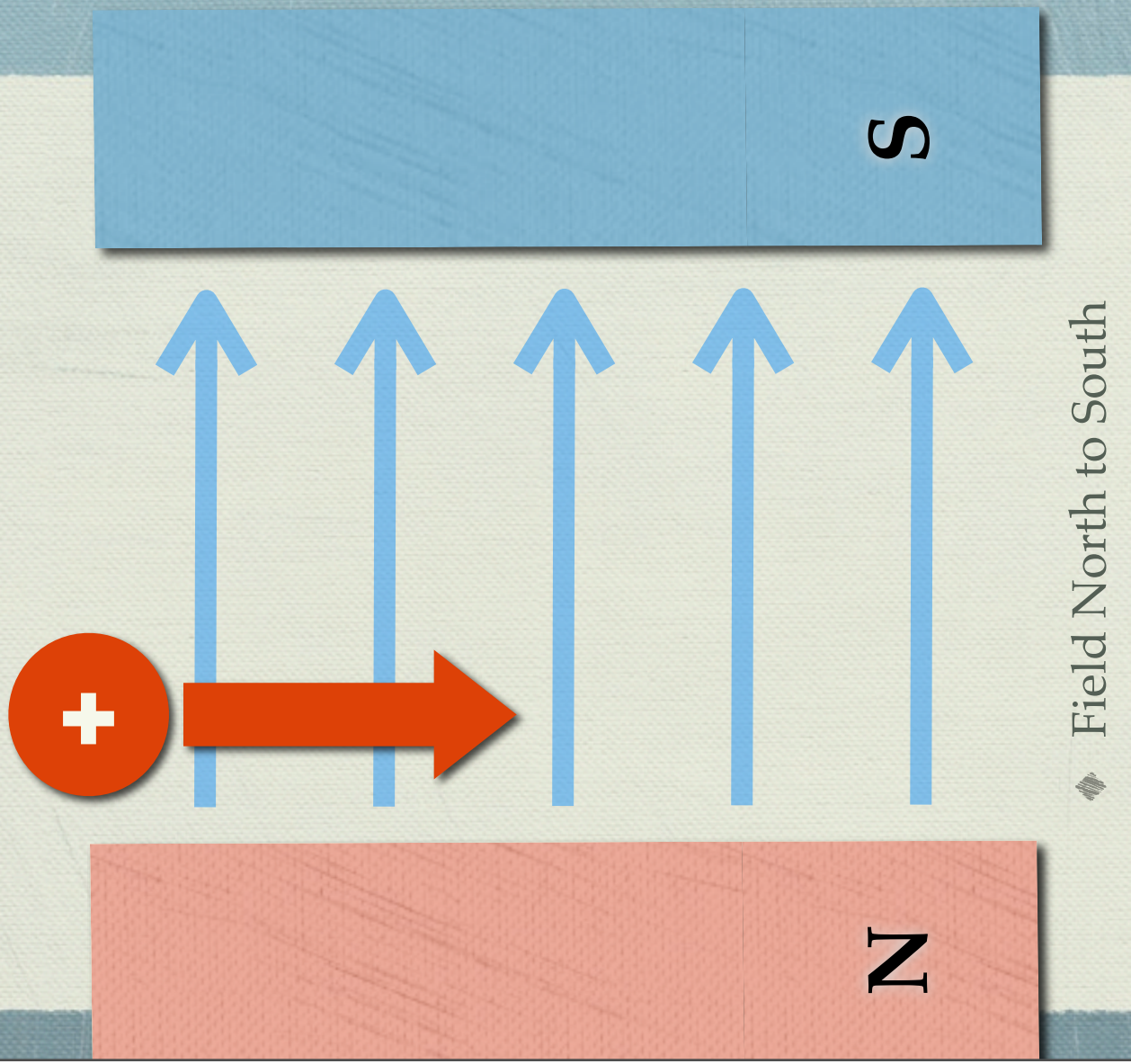


Right hand rule

- Your thumb always shows the direction of the flow of positive charge
- Your fingers always point to South
- Creating the loop makes the field stronger
- A coil of **n** loops would make it **n** times stronger still

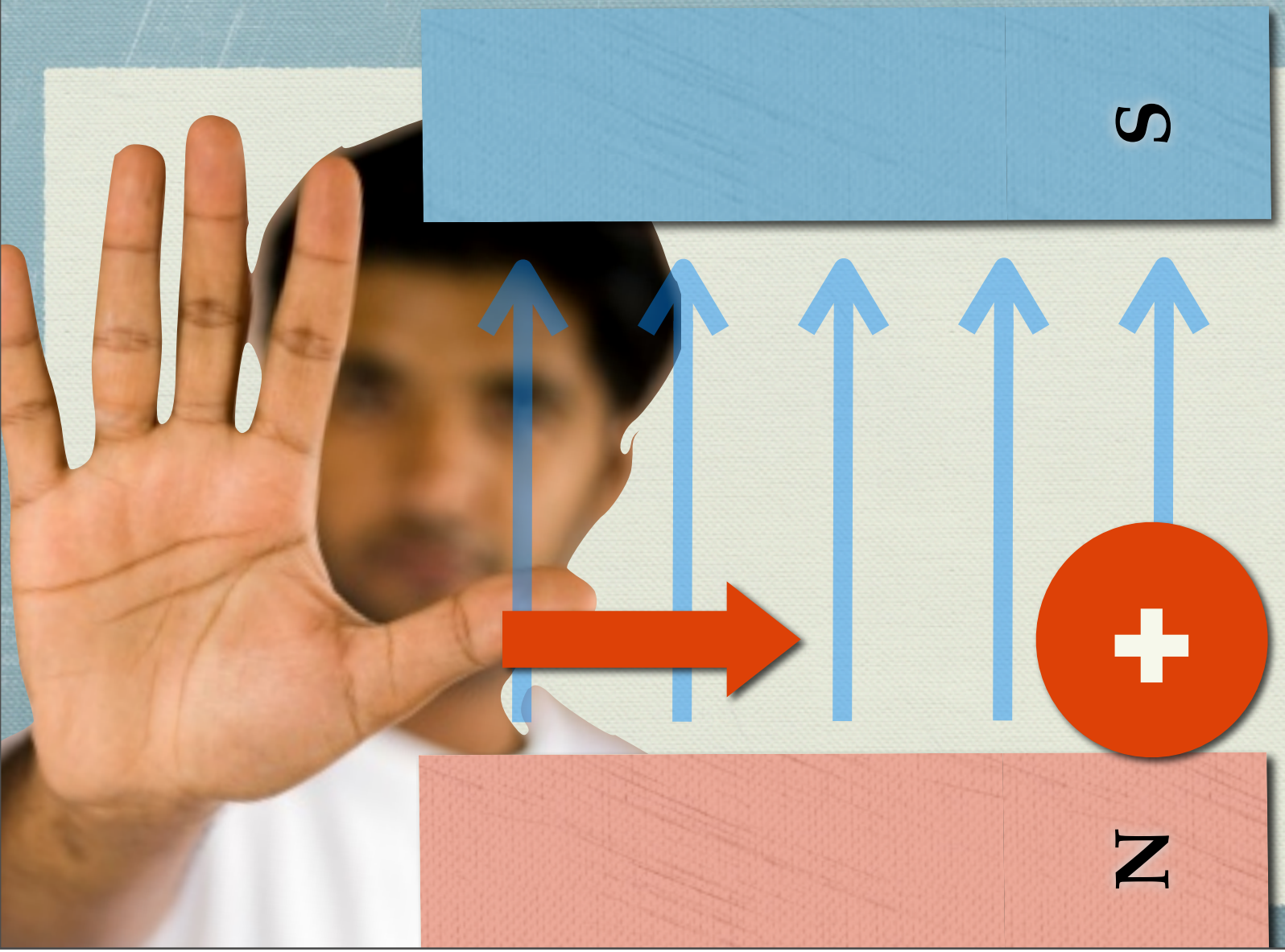


Force on a single charge



- Field North to South

Force on a single charge



- Field North to South

Force on a charge

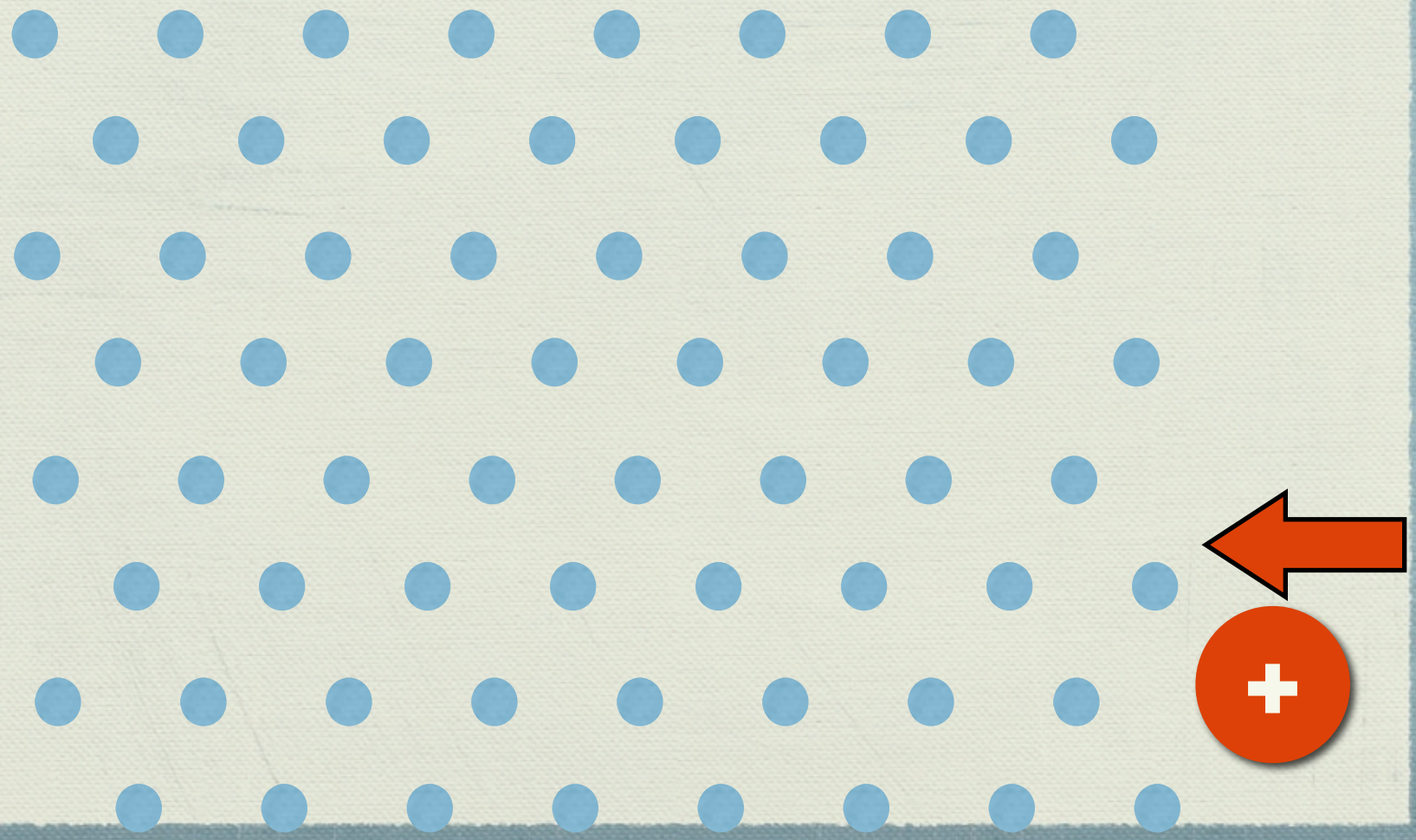
$$F = qvB\sin\theta$$

- Force - Newtons
- q - single charge in Coulombs
- v - velocity in m/s
- B - Magnetic Field in Tesla
- Strongest at a right angle

The force on the wire depends on the current, the length of the wire, the magnetic field, and its orientation.

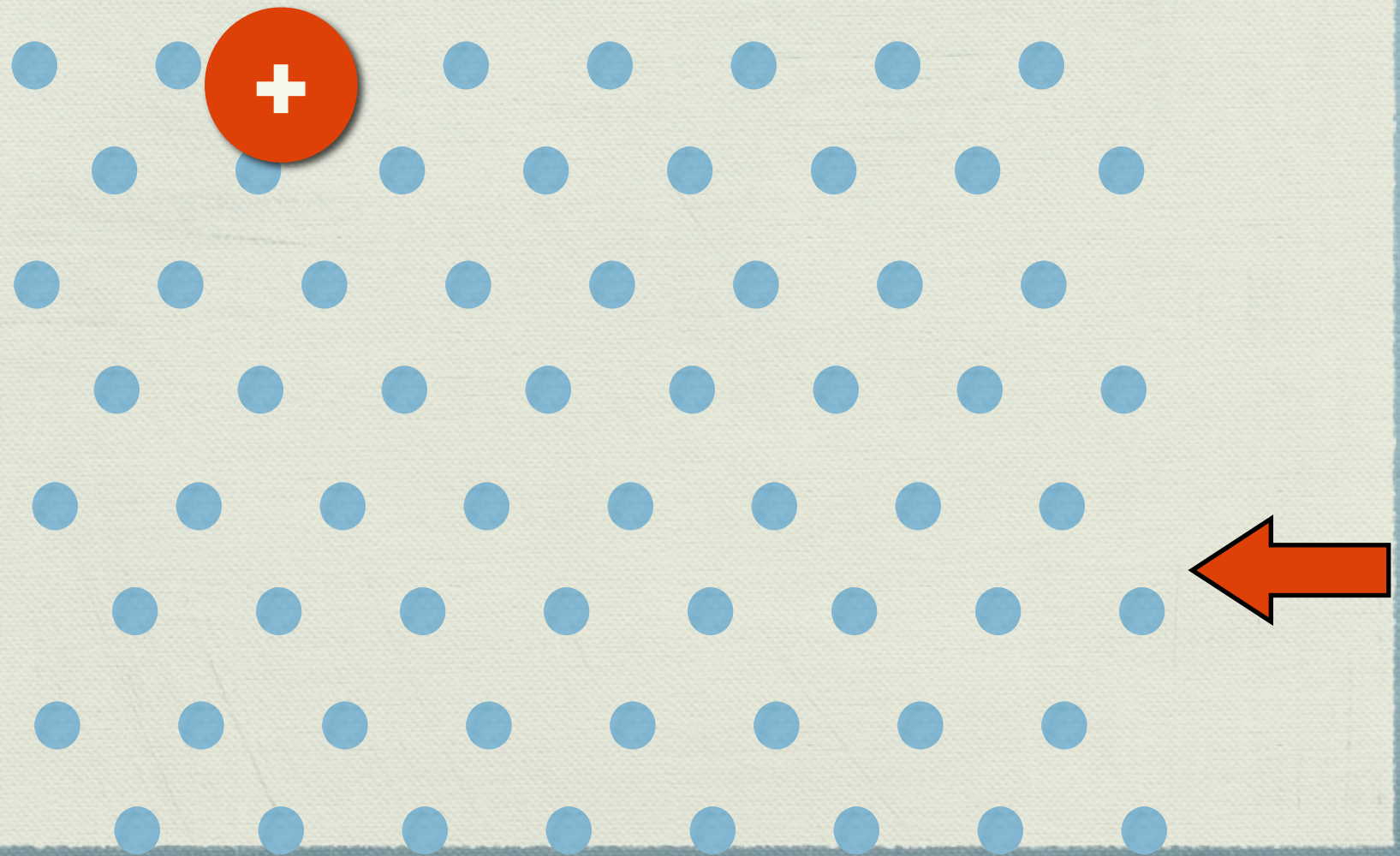
A single charge

- Field North to South - Out of the screen



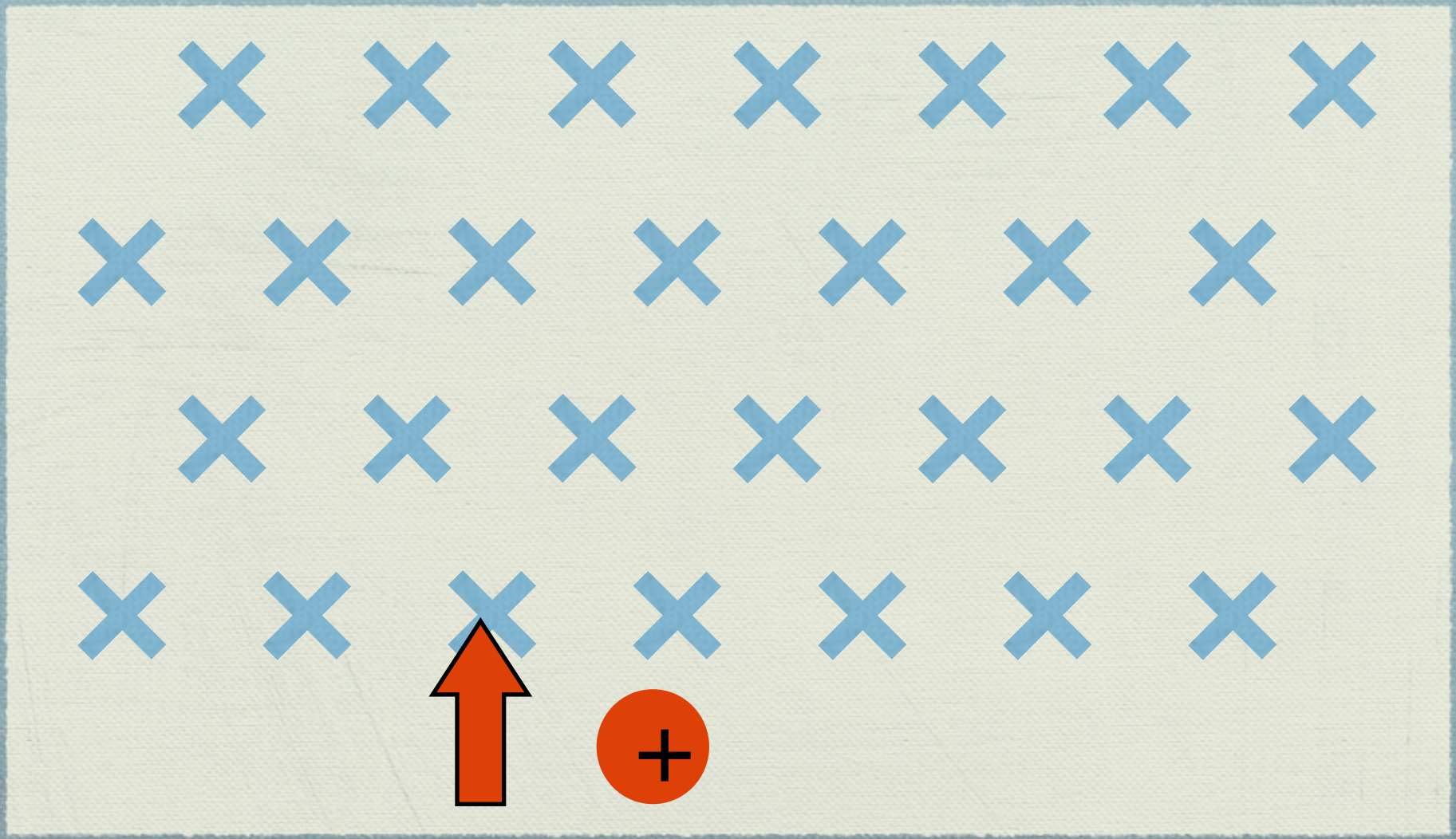
A single charge

- Field North to South - Out of the screen



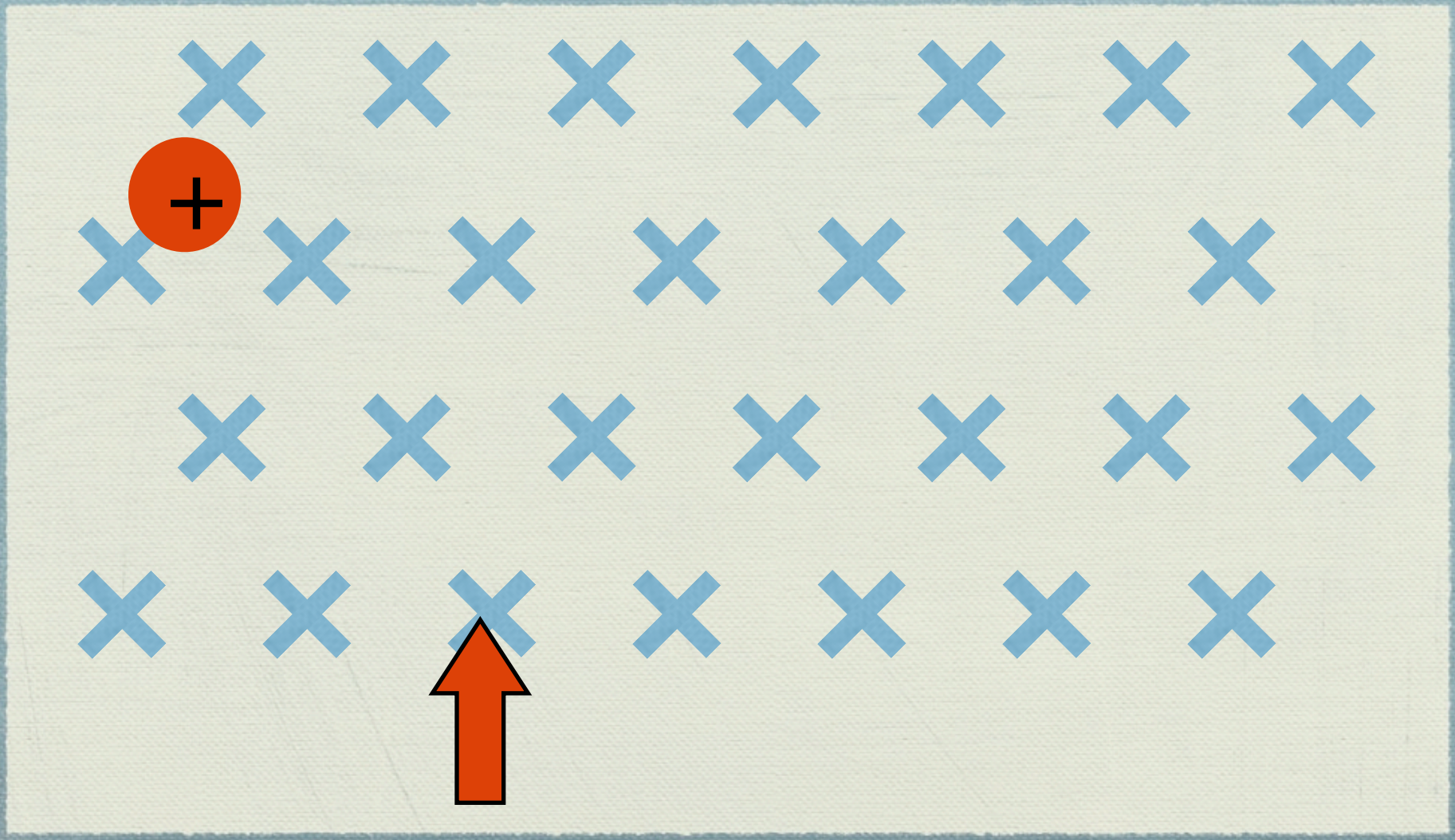
Positive or Negative

- Field North to South - into the screen



Positive or Negative

- Field North to South - into the screen



Positive or Negative

- Field North to South - into the screen