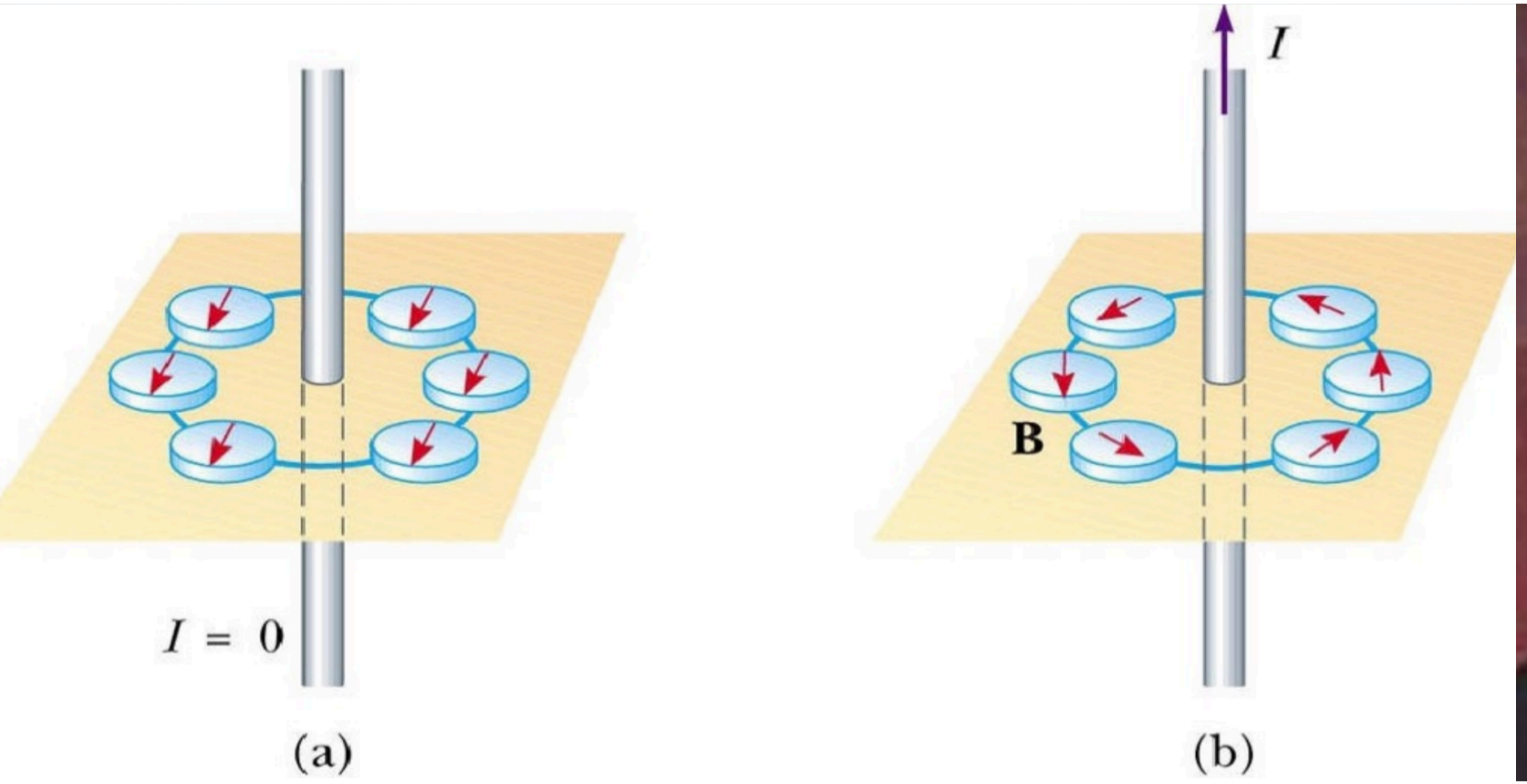
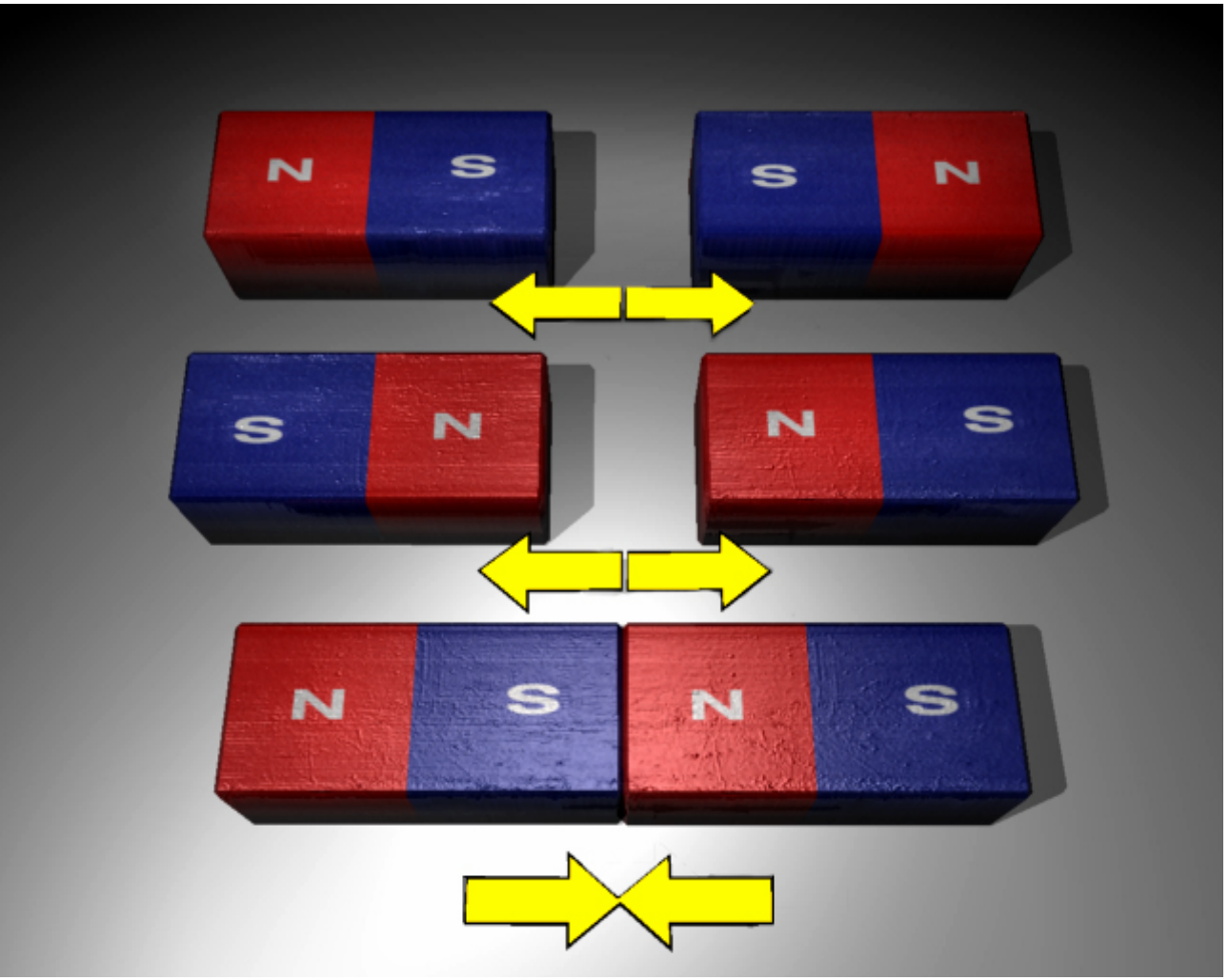
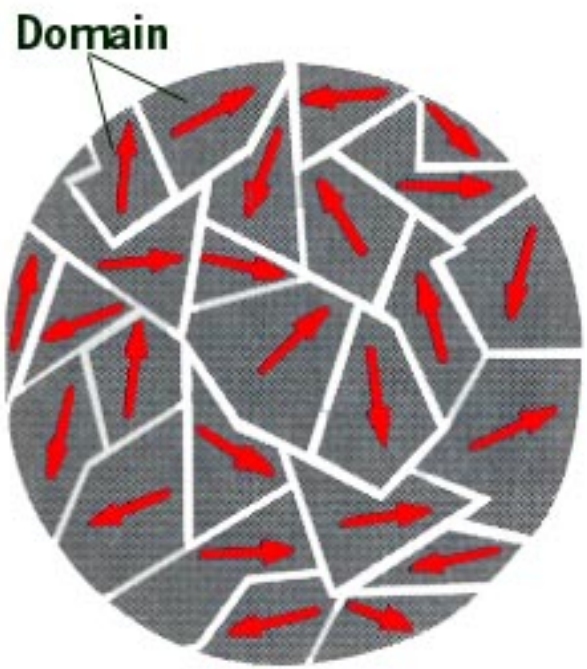
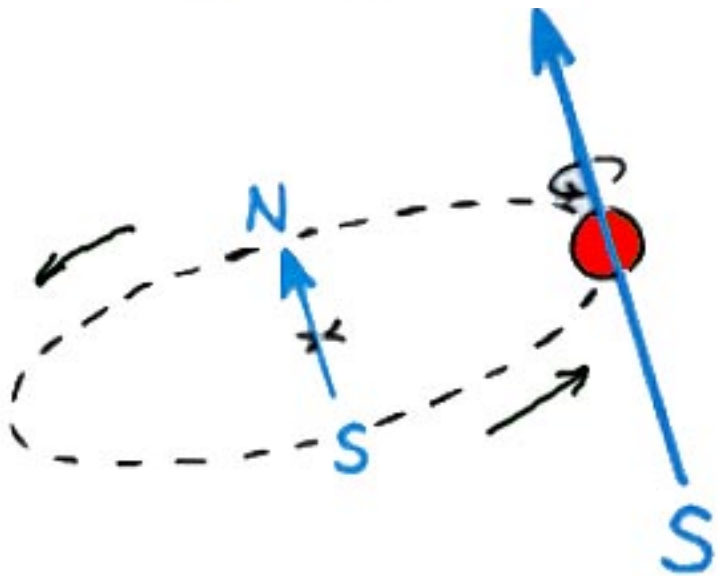


Oersted's experiment (1820): If no current, the compasses don't move, but they move to form a circular path around the wire if you put a current through the wire. Oersted concluded that **magnetism is caused by moving charges**



If moving charges cause a magnetic field, what's the moving charge in an iron bar magnet?





Domains: groups of aligned atoms

electrons all spinning in the same direction, so groups of atoms are aligned in the same direction

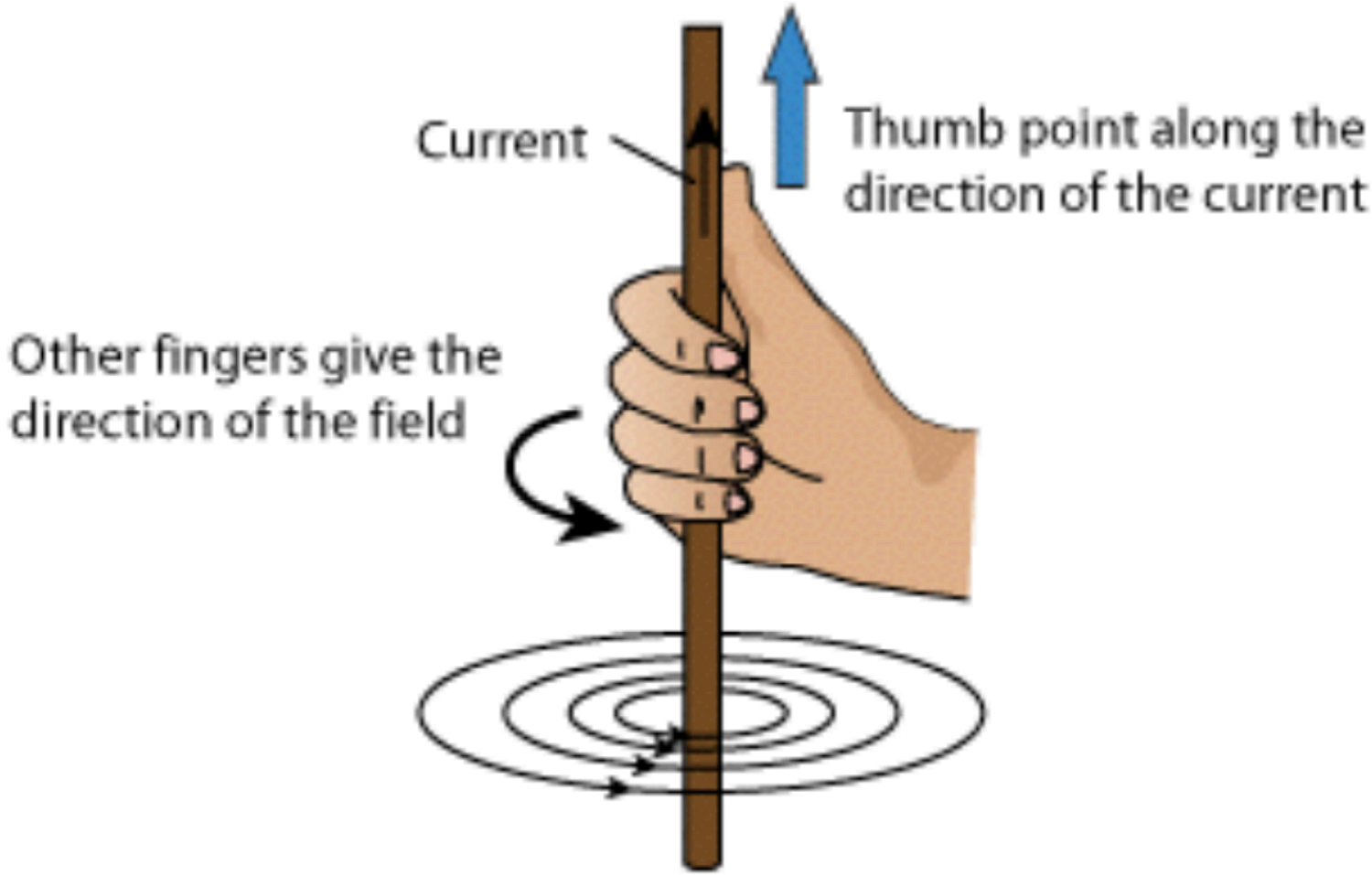
- The difference between an ordinary piece of iron and an iron magnet is the alignment of the domains
- In common iron, domains are randomly oriented
- But in presence of a strong magnetic field, the aligned domains grow

I.e. bringing a magnet close to a paper clip

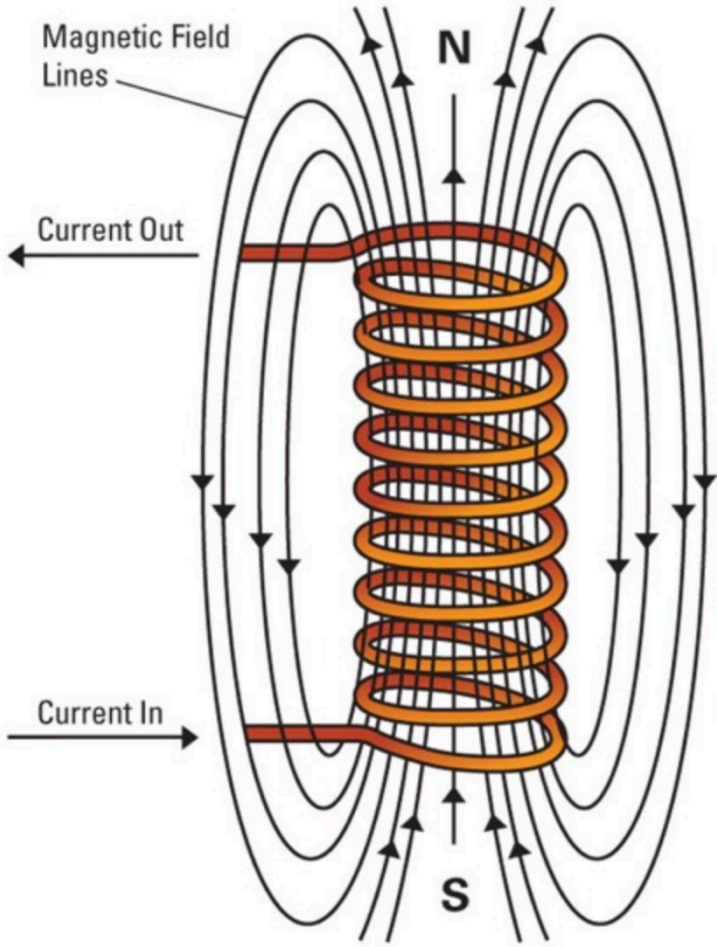
- If a permanent magnet is dropped or heated, the domains may jostle out of alignment

External magnetic field can twist the domains into alignment.
Ferromagnetic materials: iron, cobalt, nickel, and combinations
– Domains remained aligned after they've been twisted by an external magnetic field

Paramagnetic materials:
- Domains return to unaligned state

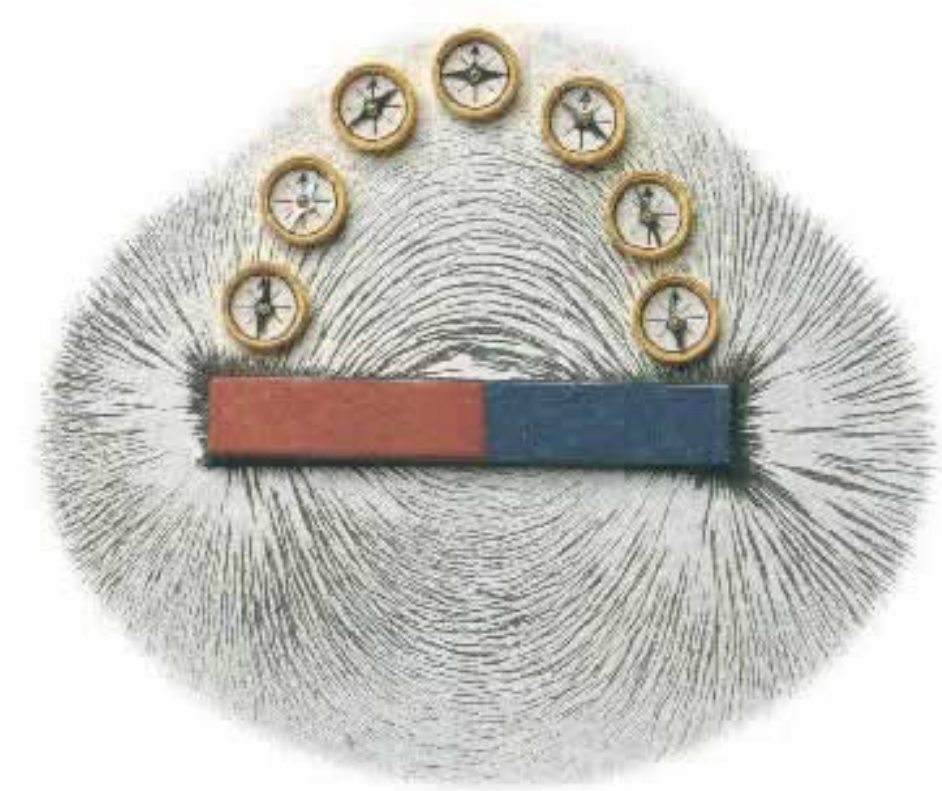


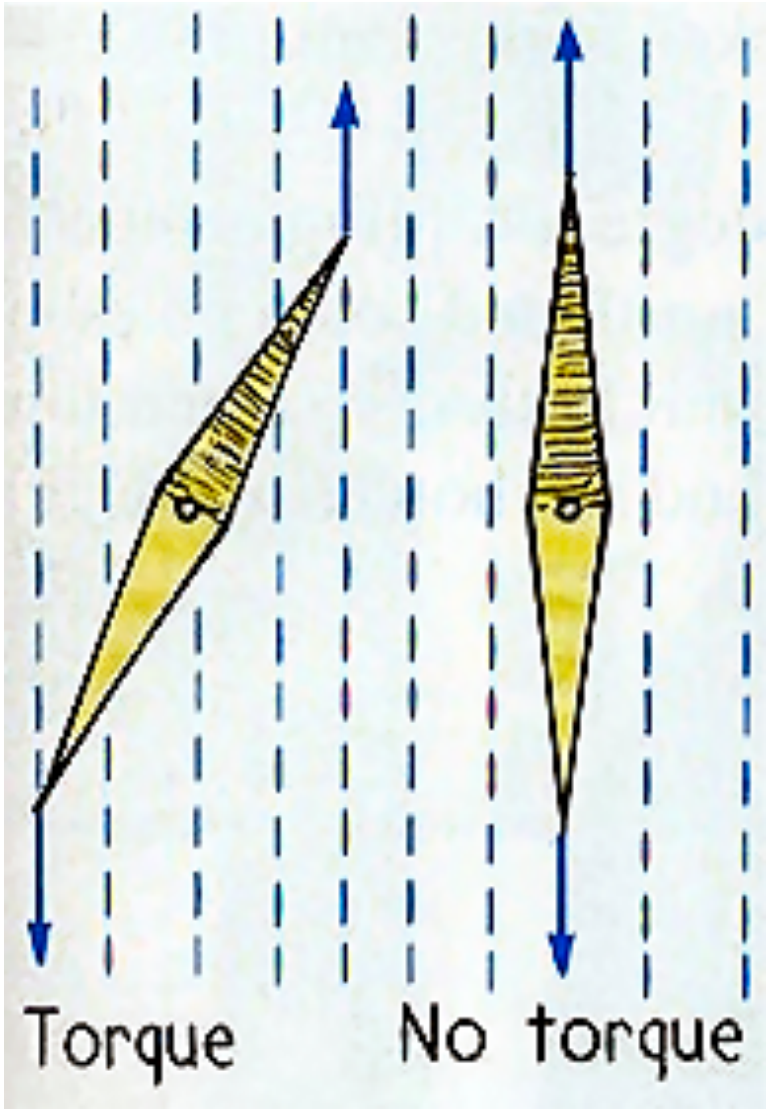
Right Hand Grip Rule


Magnetic Field Lines
N
Current Out
Current In
S

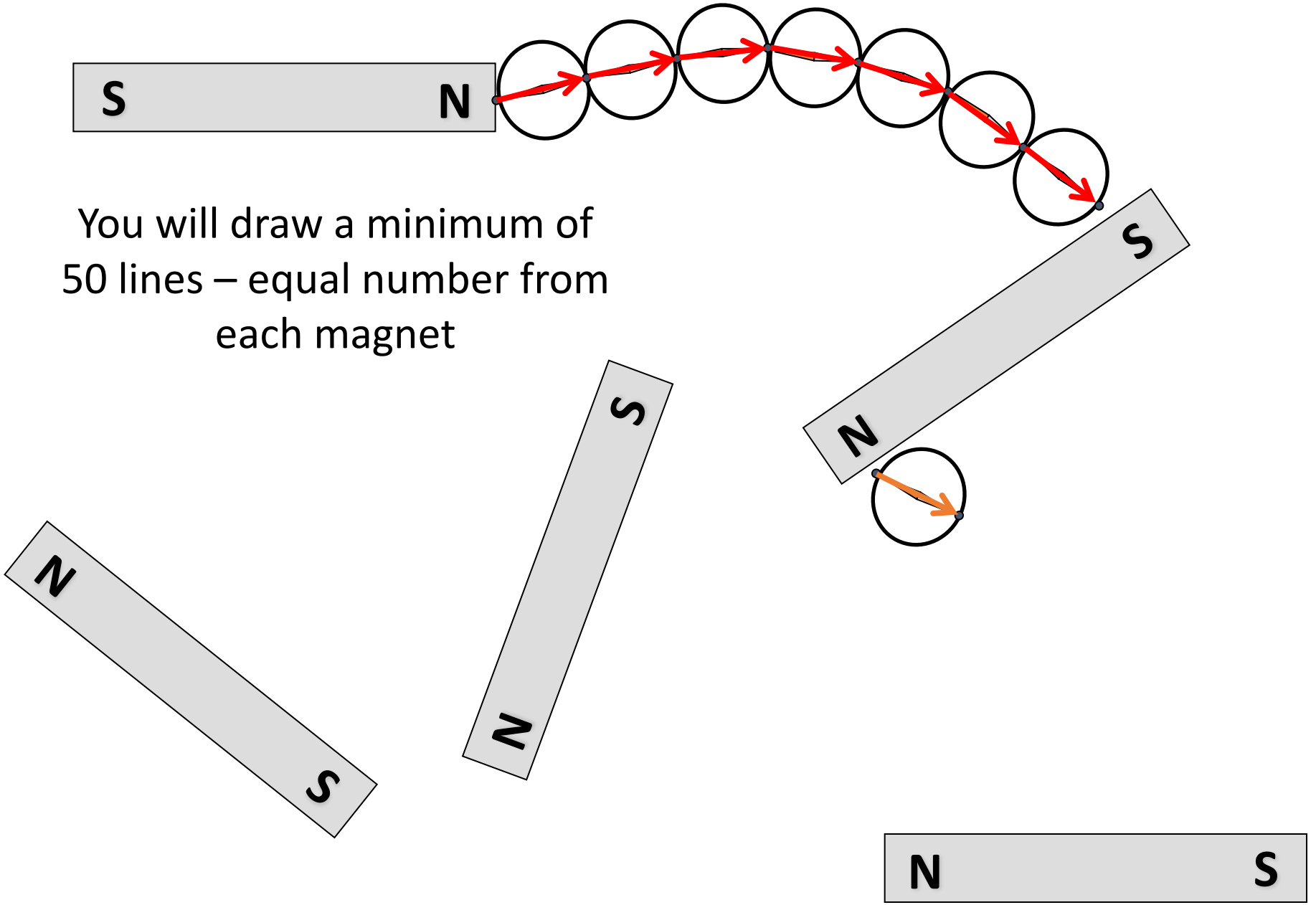
Detecting Magnetic Field

- **Iron filings on a piece of paper**
- **Compass**





- **DO NOT put filings directly on magnet**
- Make sure that your magnets are true by first checking to see if N - S attract and N – N or S – S repel
- Place the magnets on the table and place the manila folder over it
  - 1: Just 1 magnet
  - 2: 4 different combinations/orientations of 2 magnets
  - 3: Use the compasses to map the magnetic field lines on the following slide
- Add iron filings, draw the pattern on your lab paper
- Arrows (→) start at North and point towards South
- Return filings to the shaker.
- **DO NOT put filings directly on magnet**


S
N
You will draw a minimum of
50 lines – equal number from
each magnet
S
N
S
N
N
S
N
S

1. What are magnetic domains?

A. Atoms randomly aligned

B. Electrons flowing in an iron

C. Moving electric charge

D. Clusters of protons

E. Clusters of aligned atoms

2. How is a magnetic field produced?

A. flow of electrons and neutrons

B. motion of electric charge

C. force exerted by the poles

D. path of magnetic domains

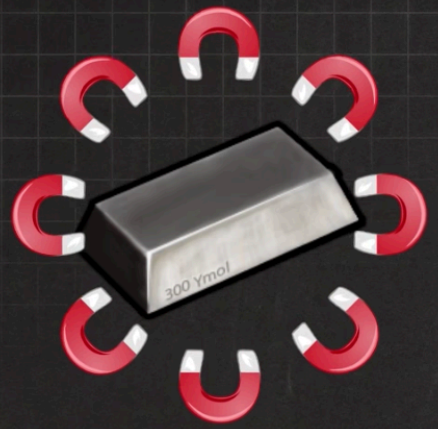
3. A magnet is broken into two equal pieces. What happens to each piece?

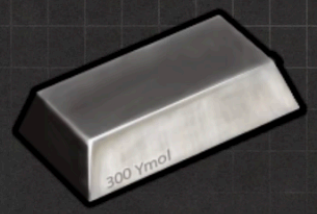
A. One piece stays magnetized while the other becomes unmagnetized.

B. One piece is stronger than the other

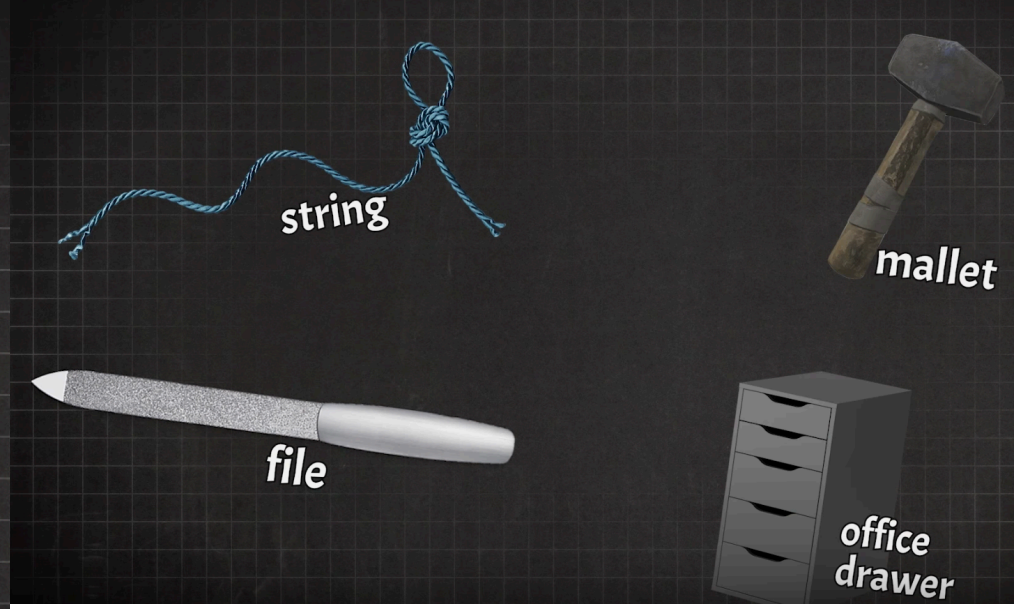
C. Each piece retains equally strong poles

D. One piece acquires the North Pole while the other has the South Pole.

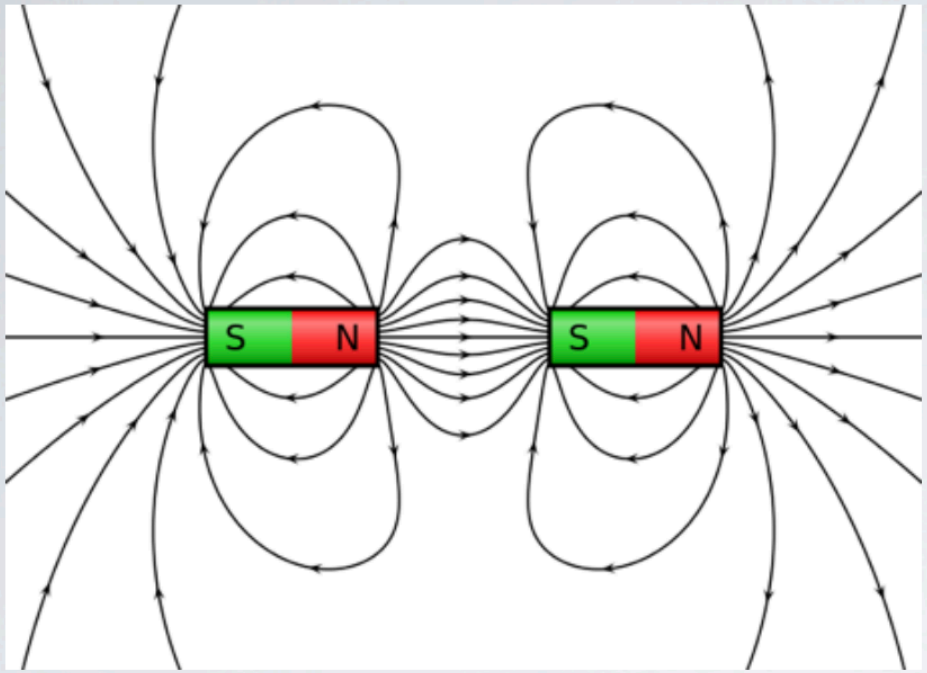


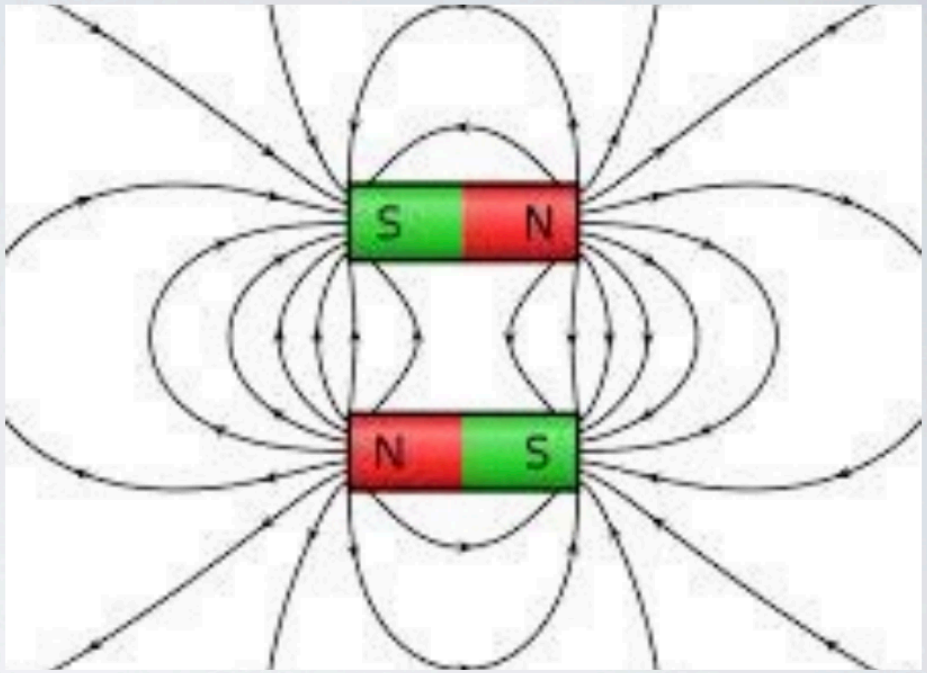


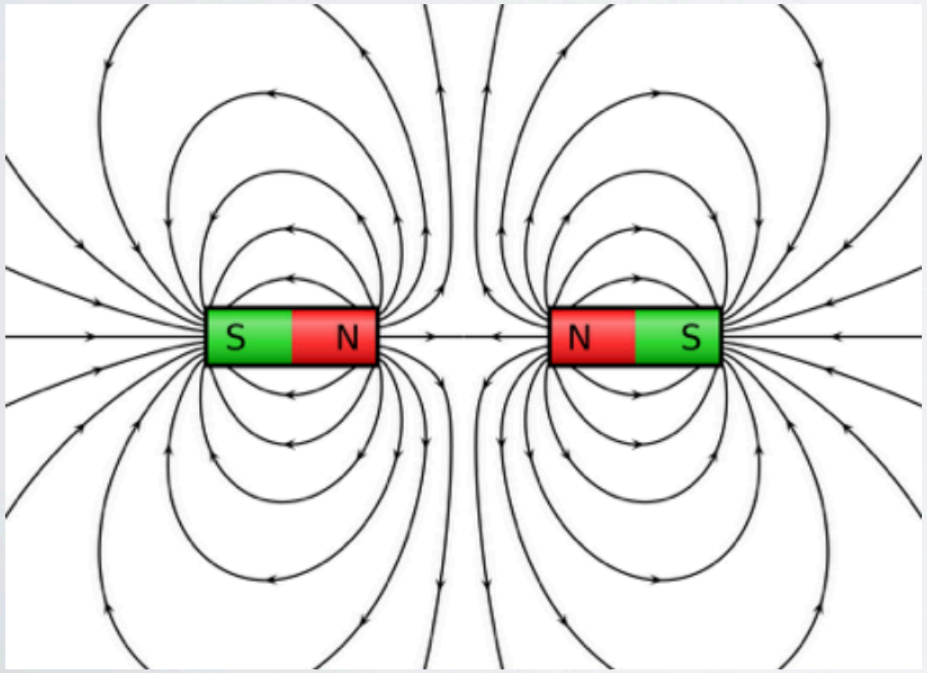
- two identical iron bars
- one magnetized, one not
- bars have same weight, size, and are visually indistinguishable
- how do you figure out which one is magnetized?

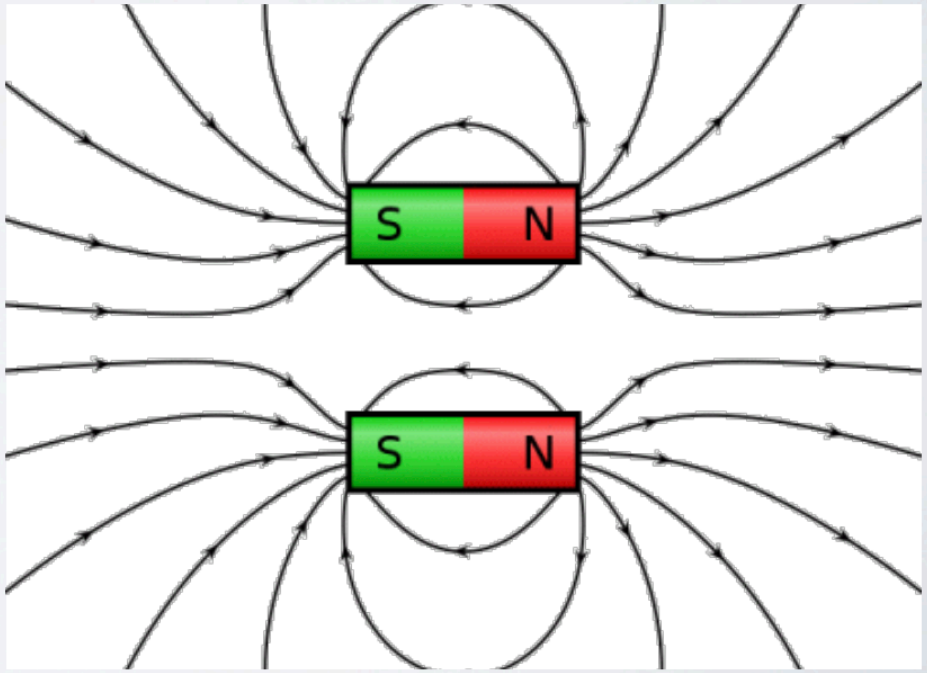



S
N


S
N
S
N


S
N
N
S


S
N
N
S


S
N
S
N