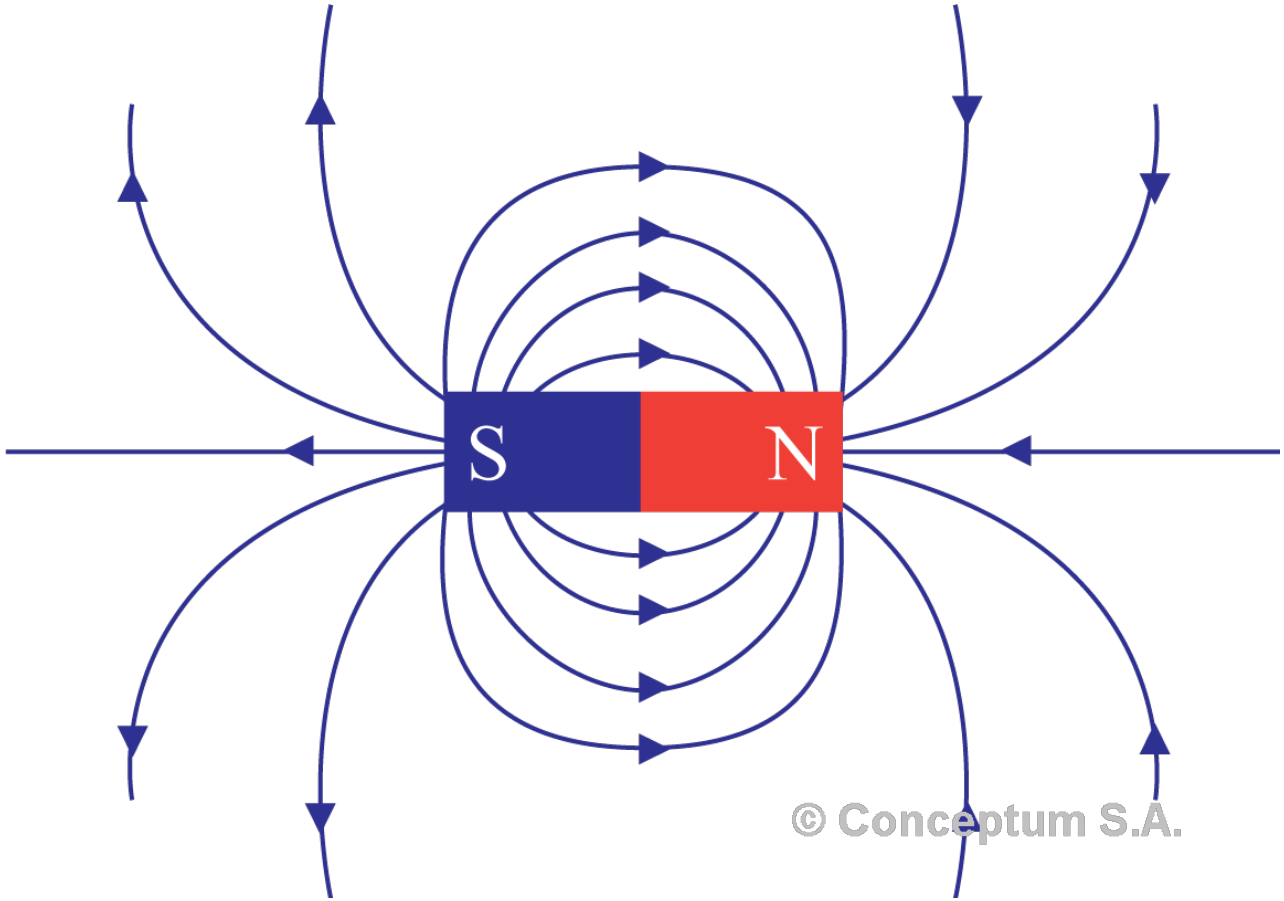
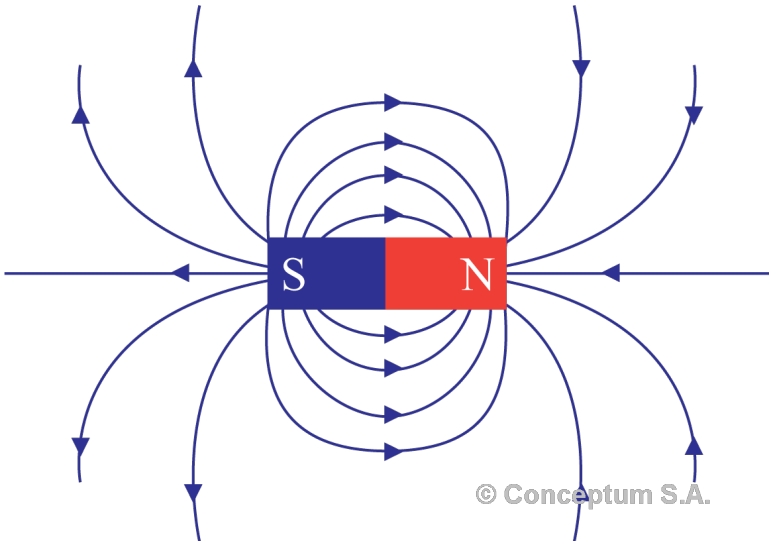
Magnetism

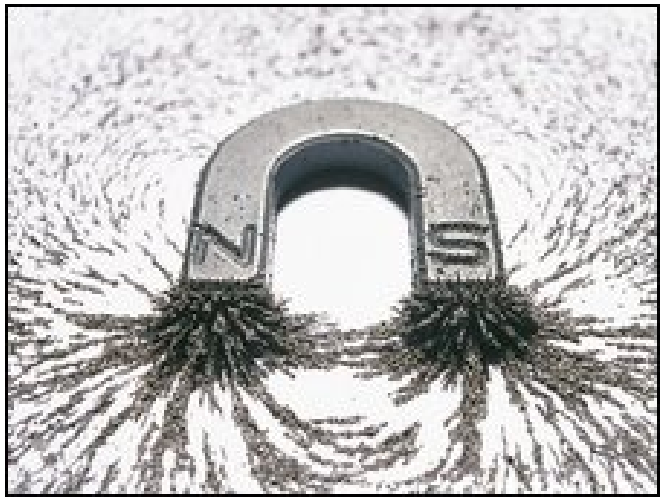


Magnetism



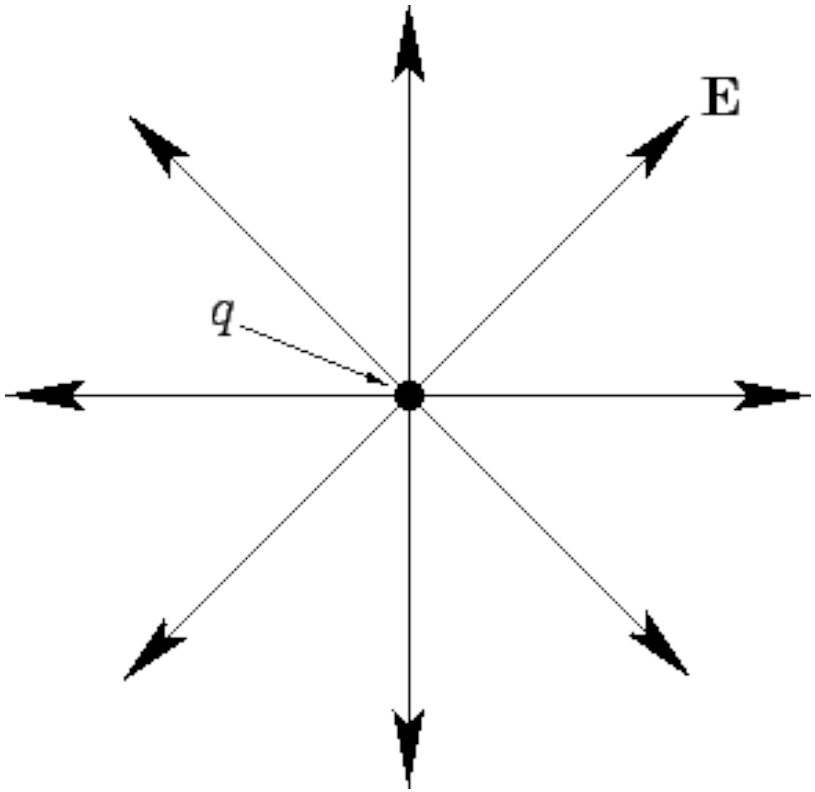
- North and South Poles

Magnetism



- North and South Poles
- "Dipole"

Magnetism



- North and South Poles
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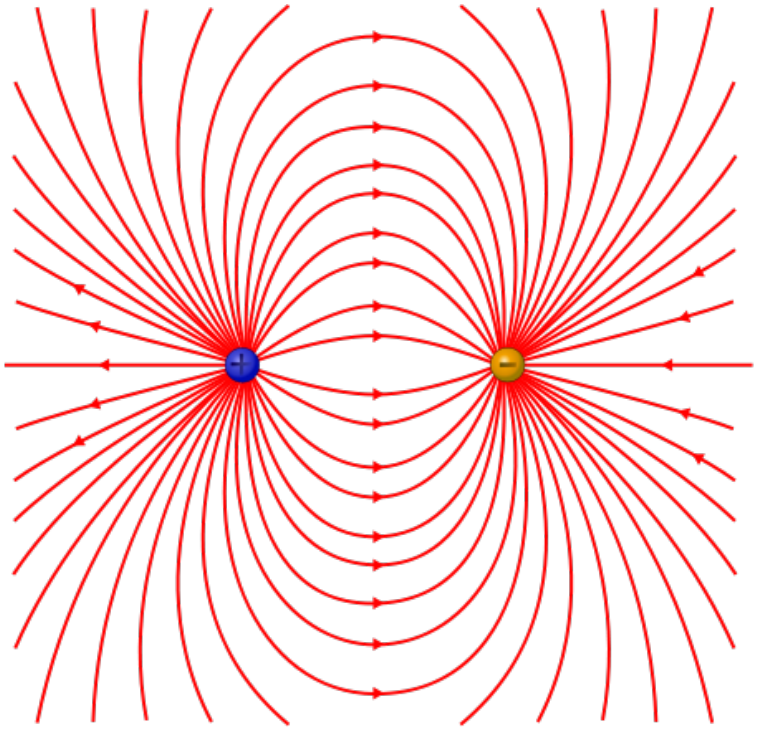
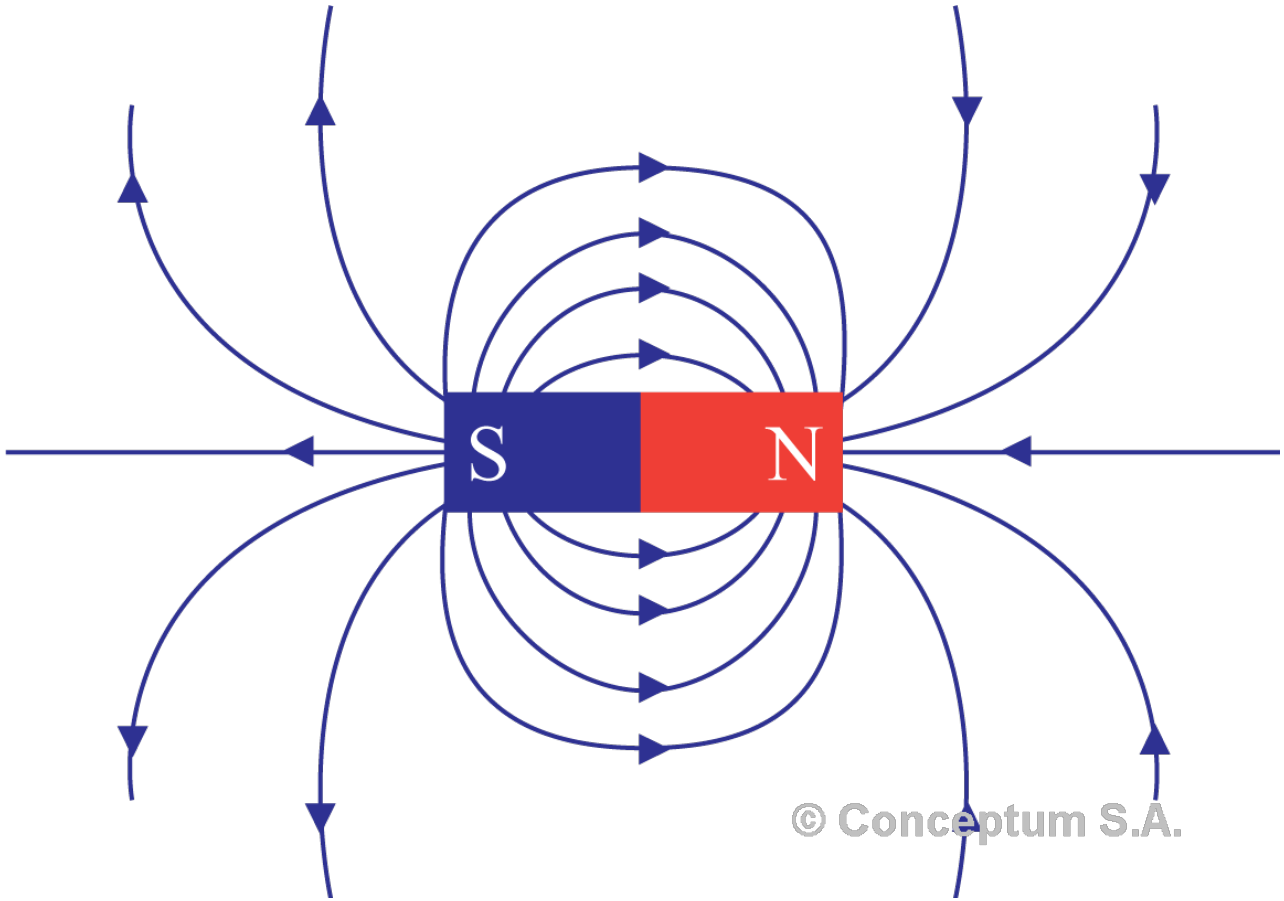
- Electric monopoles exist

Magnetism



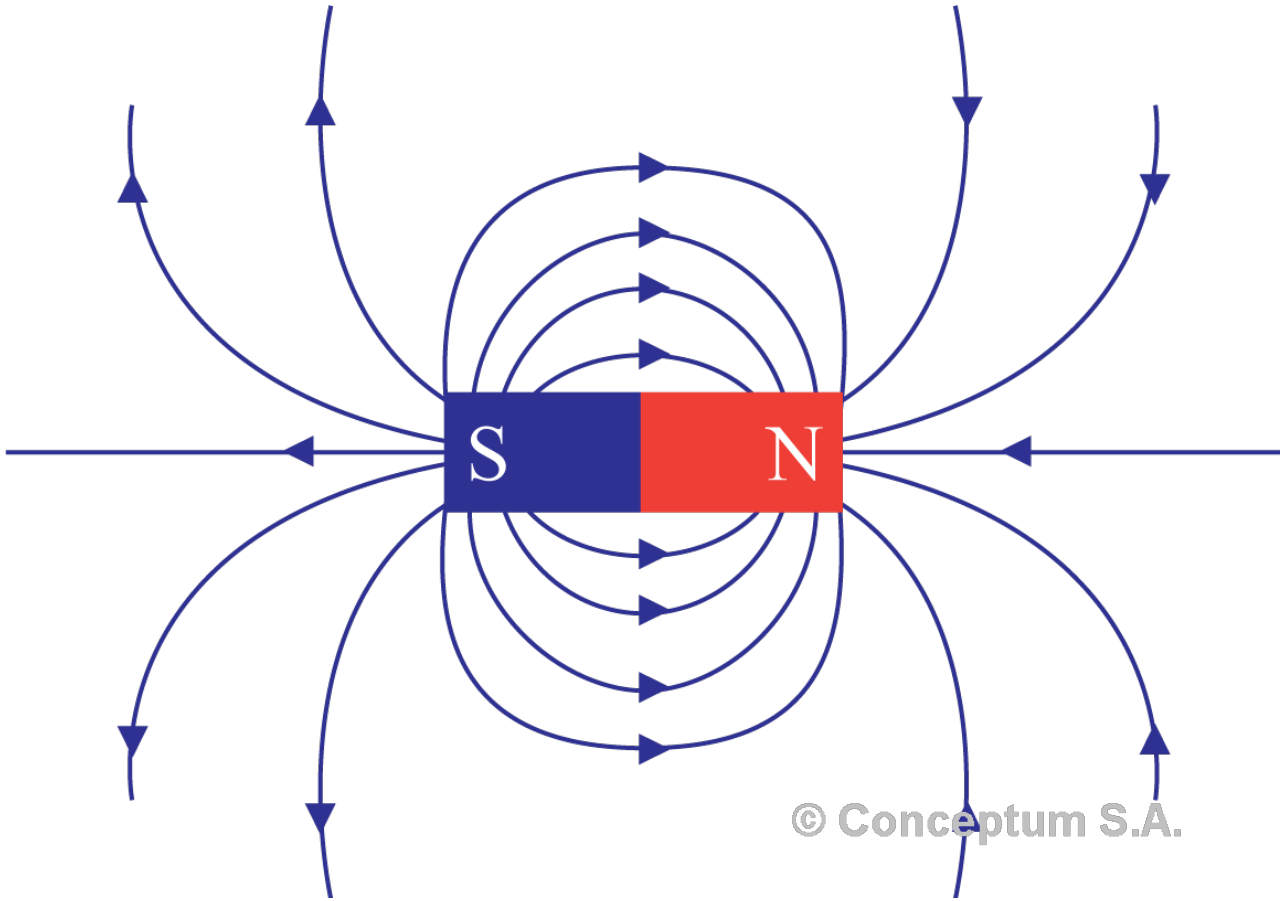
- North and South Poles
- "Dipole"
- Electric monopoles exist
- So do electric dipoles

Magnetism



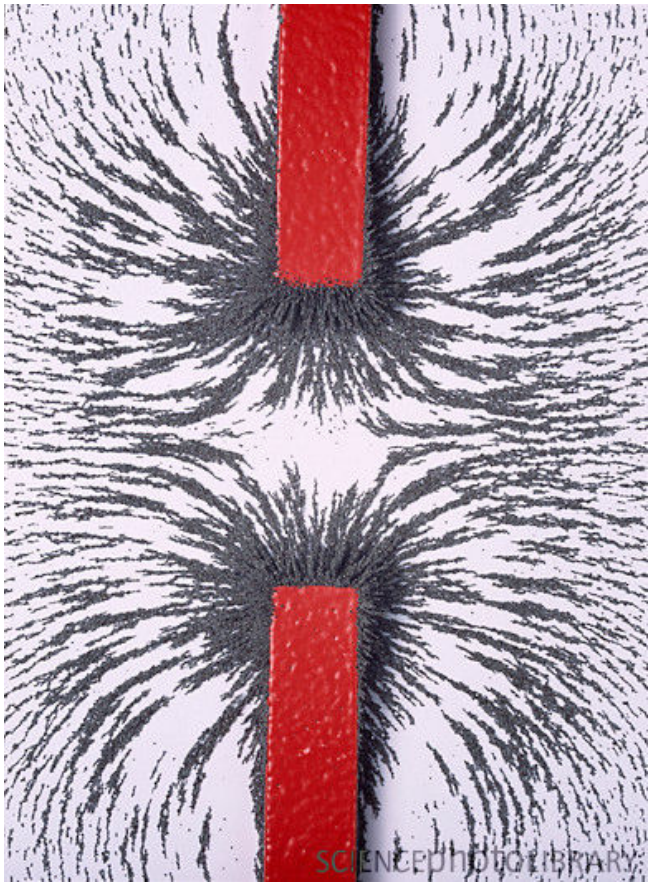
Nobody has *ever* discovered a magnetic monopole.

Magnetism



Nobody has *ever* discovered a magnetic monopole.
Field lines point *North to South*.

Magnetism



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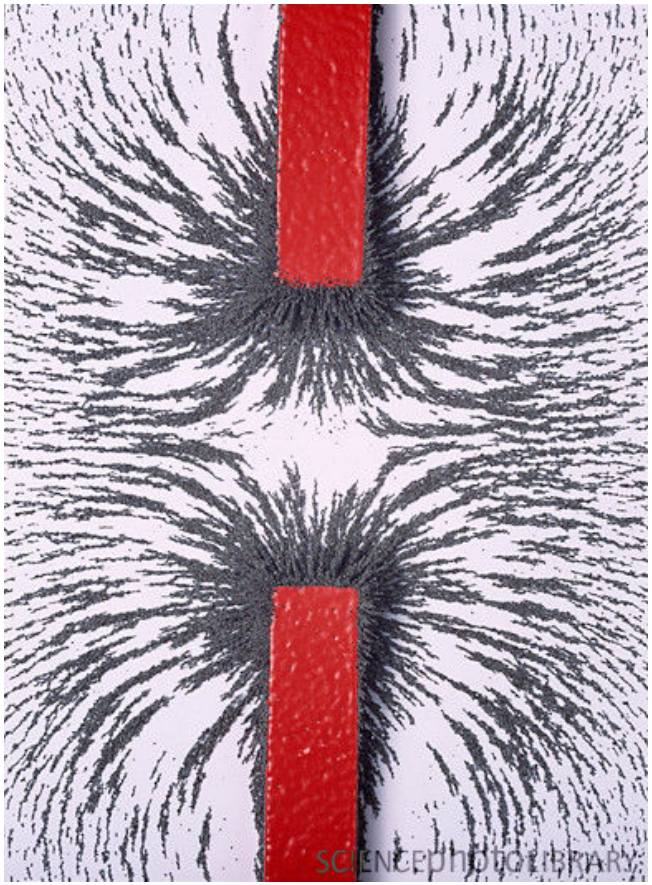
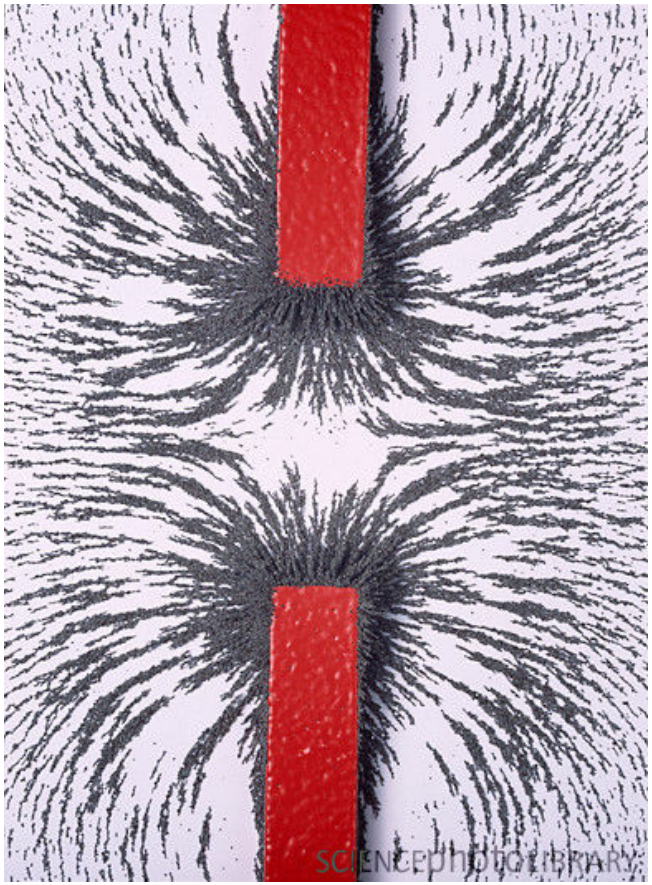


Like Poles Repel

Magnetism



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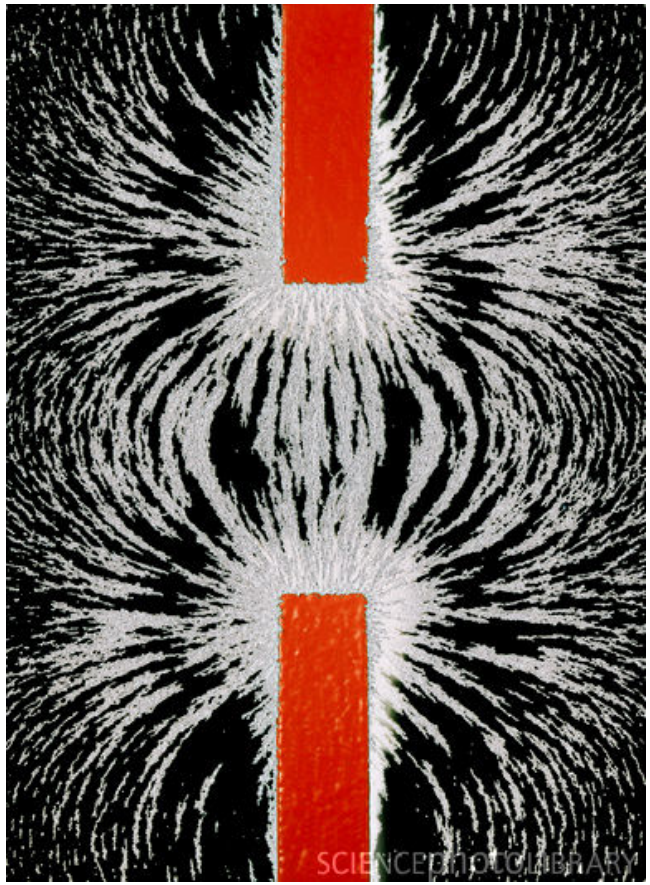
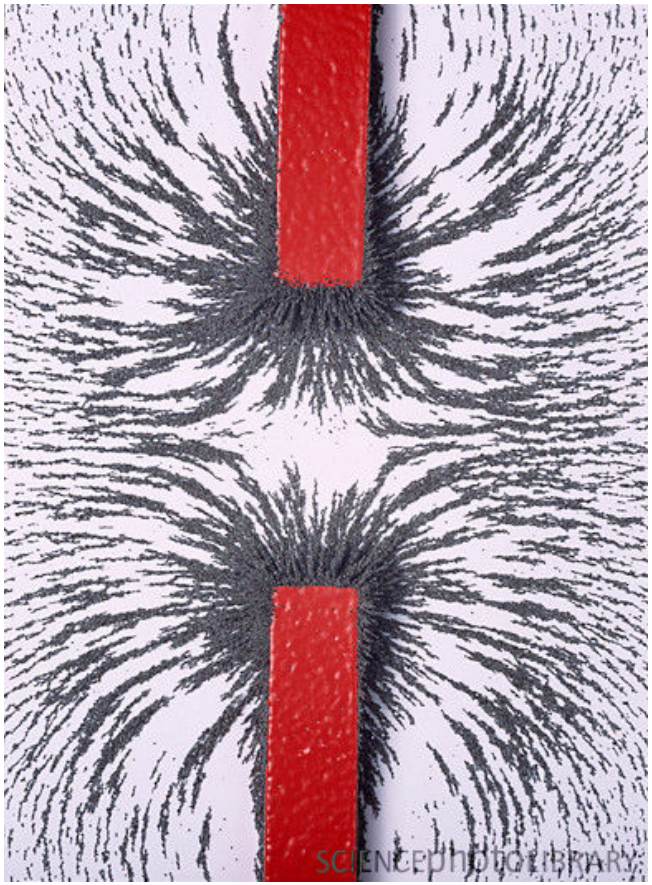


Opposite Poles Attract

Magnetism



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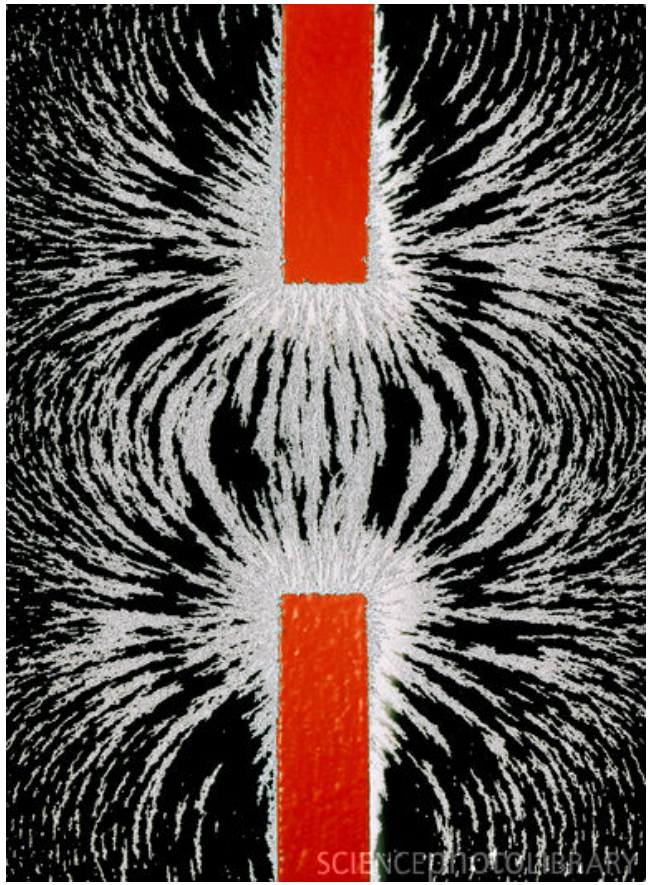

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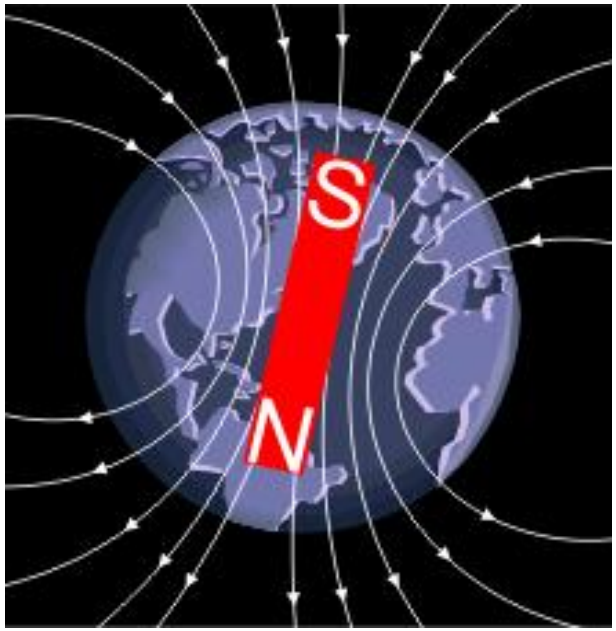

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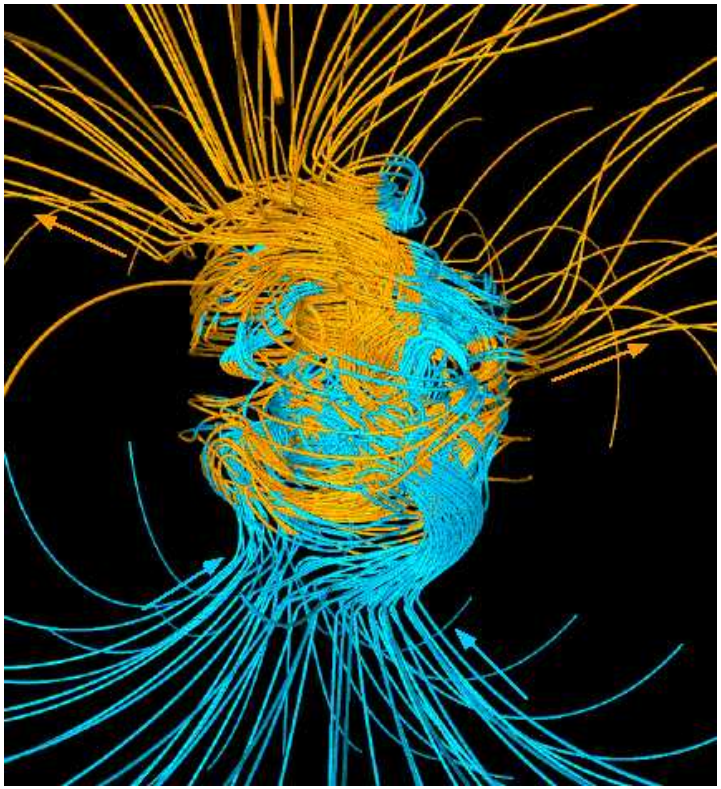

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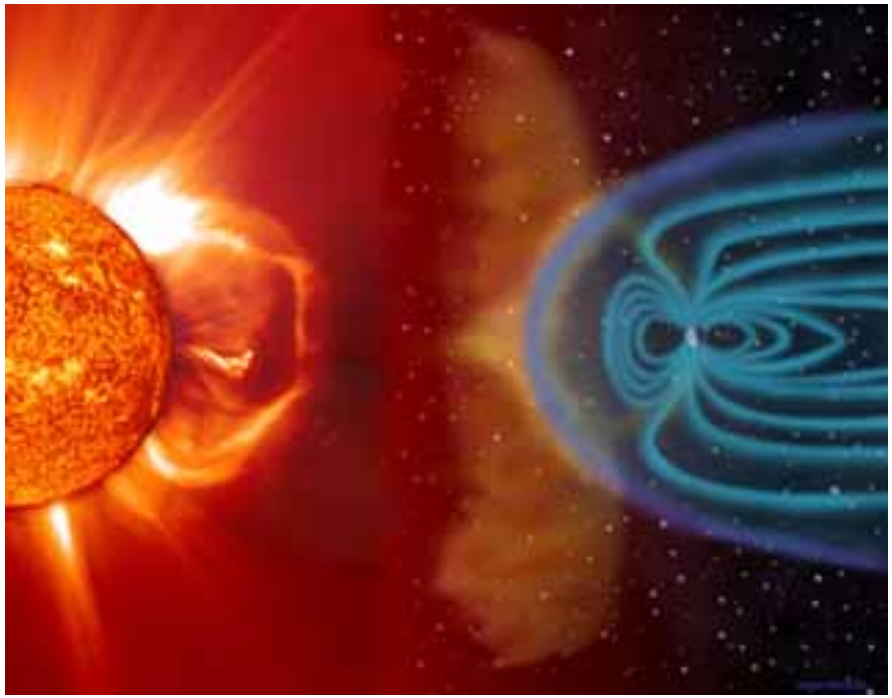

Source of Magnetic Fields

Moving Electric Charge Creates a Magnetic Field.

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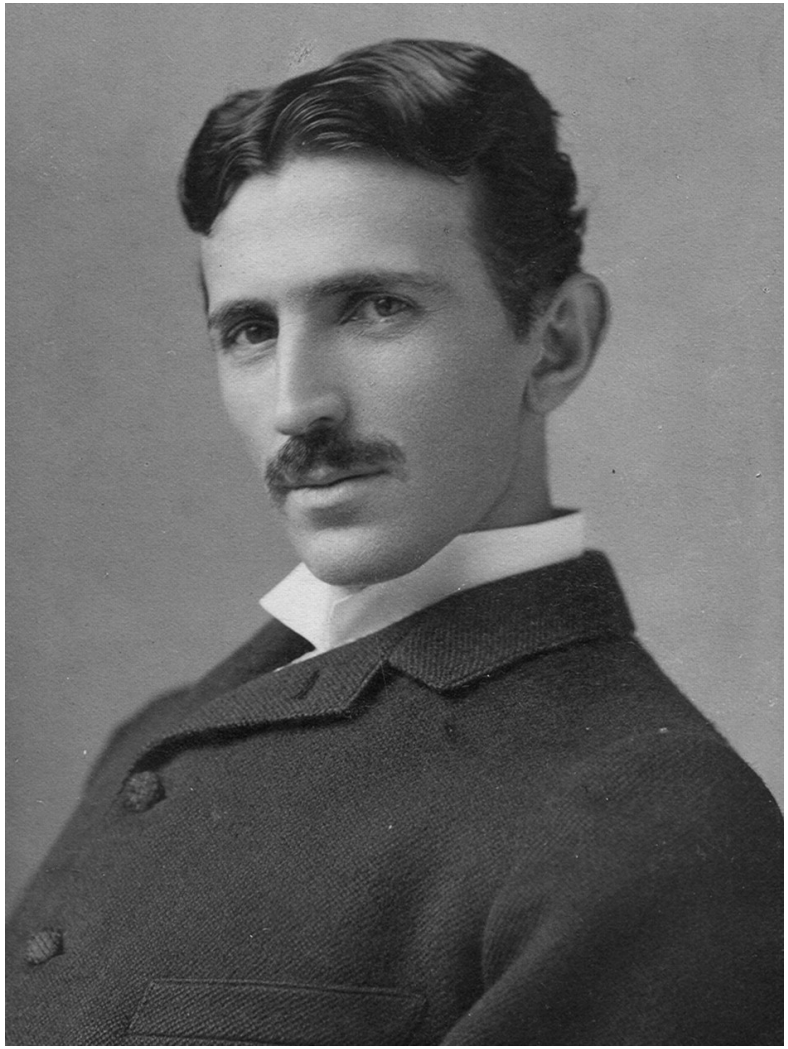
θ is the angle between the velocity and field vectors.
$\mathbf{B}$ is the magnetic field and has units of Teslas (T).



Nikola Tesla

Lorentz Force

Example:
An electron traveling to the right at $2.00 \times 10^3 m/s$ enters a uniform magnetic field of magnitude 2.5 T into the page. What is the magnitude and direction of the force on the electron?

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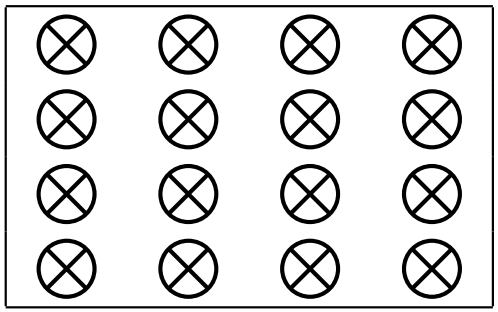
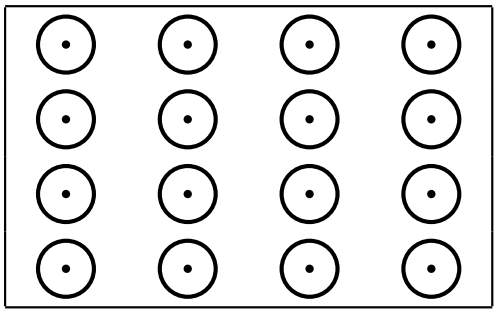
$q_e = 1.60 \times 10^{-19} C$

Vectors Again

Into the Page

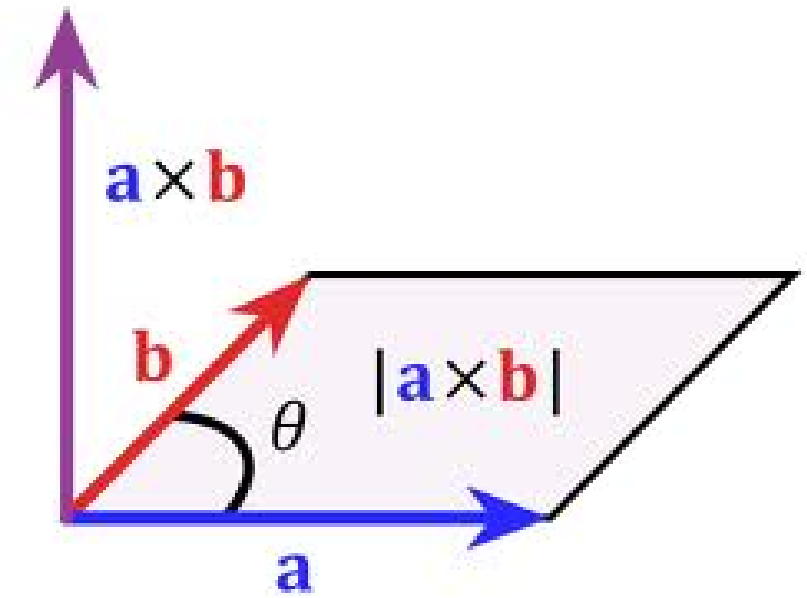


Out of the Page



Vectors Again

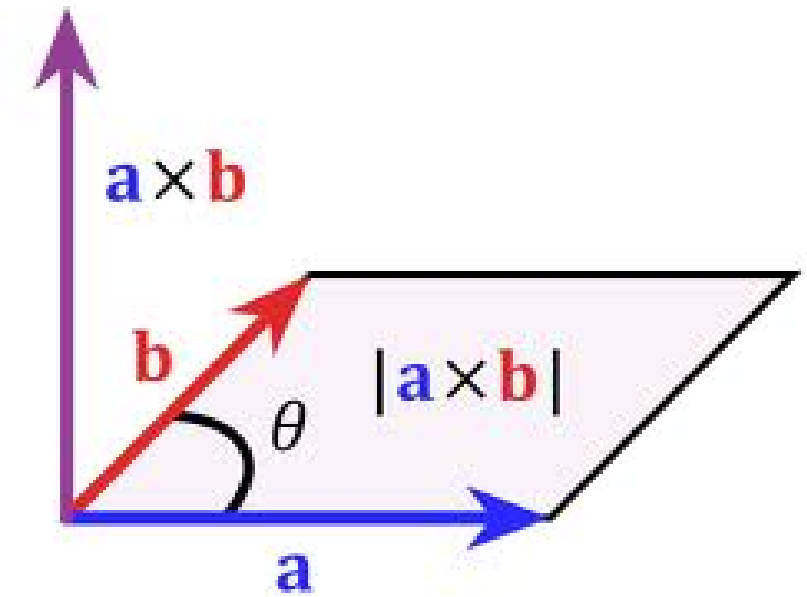
Cross Products



The answer to $\mathbf{a} \times \mathbf{b}$ is perpendicular to both **a** and **b**.

Vectors Again

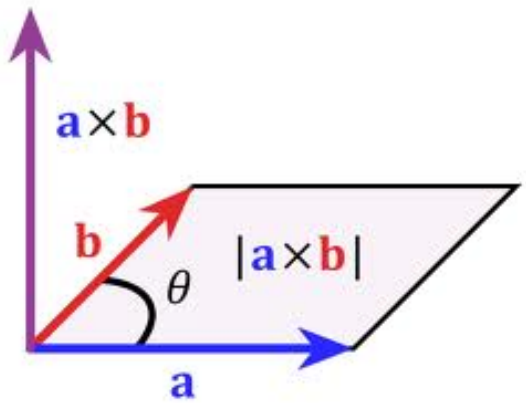
Cross Products



The answer to $\mathbf{a} \times \mathbf{b}$ is perpendicular to both **a** and **b**.
This is what the RHR is for.

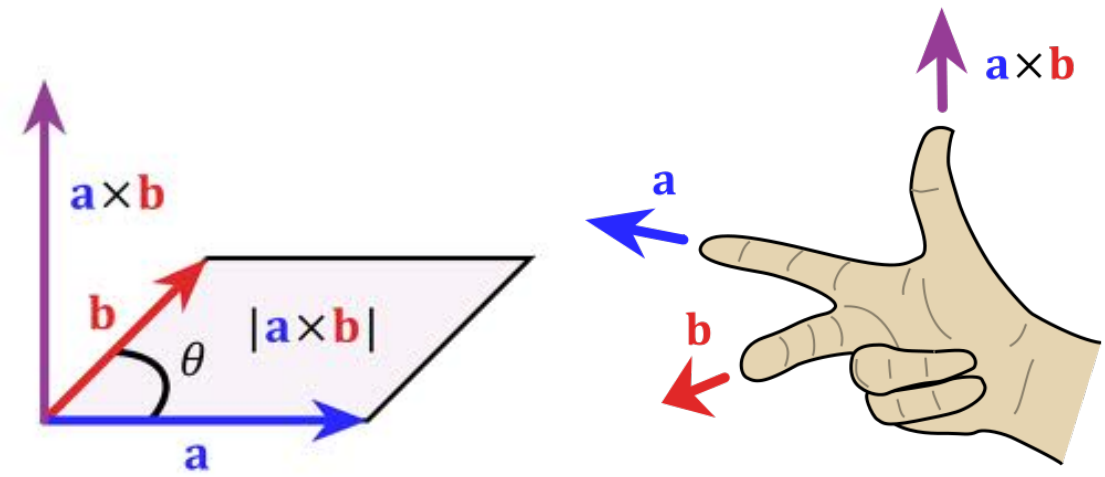
Vectors Again

Right Hand Rule



Vectors Again

Right Hand Rule



Vectors Again

Right Hand Rule
and Lorentz Force

- Straight hand, point fingers in direction of velocity

Vectors Again

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- Straight hand, point fingers in direction of velocity of charged particle.
- Bend fingers in direction of **B**-field.

Vectors Again

Right Hand Rule
and Lorentz Force

- Straight hand, point fingers in direction of velocity of charged particle.
- Bend fingers in direction of **B**-field.
- Thumb is now showing you direction of $\mathbf{F}_B$.

Magnetism: Important Points

- Charges *NOT* moving w.r.t. a **B**-field do not experience a force due to that field.

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- Charges *NOT* moving w.r.t. a **B**-field do not experience a force due to that field.
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Magnetism: Important Points

- Charges *NOT* moving w.r.t. a **B**-field do not experience a force due to that field.
- A *changing* **B**-field produces an **E**-field, and a changing **E**-field produces an **B**-field.
- Stationary charge produces an **E**-field, but not a **B**-field.