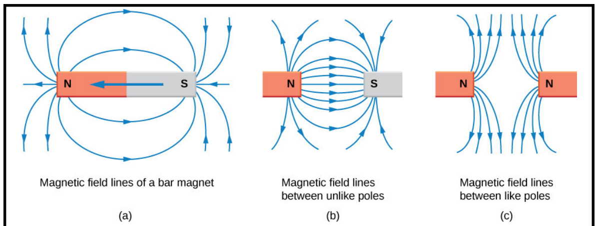
Magnetic Fields

Magnetic Field

- Magnets and electric currents create magnetic fields around themselves
- When another magnet or moving charge enters this magnetic field it will experience a magnetic force
- The magnetic field is a vector quantity

Magnetic Field Lines

- Imaginary lines around magnets and currents
- Tangents to the field lines give the direction
- Field lines go from “North” to “South”



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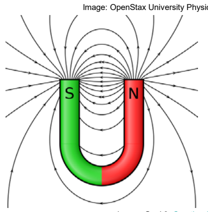

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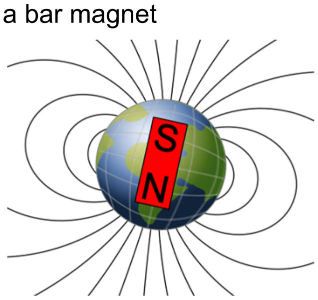
Units

- The unit of the magnetic field is the tesla (T)
- The magnetic field of the earth is about 10^{-4} T

Earth

- The magnetic field of the earth resembles that of a bar magnet



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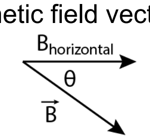
- The magnetic poles are not in the same location as the geographic poles
- **Magnetic declination** is the angle between true north and magnetic north
- The angle depends on where you are:
  - Victoria, BC (15.66° East)
  - St. John's, NF (17.59° West)
  - Winnipeg, MB (2.72° East)
- This angle changes due to changes in Earth's magnetic field
  - Current change in Winnipeg is 0.085°/y West

- **Magnetic inclination** or magnetic dip is the angle between the horizontal plane and the magnetic field vector.



- This value depends on your location since the Earth and the magnetic field is curved.
  - At the equator, 0°
  - At the poles, 90°
  - Winnipeg, 74.5°

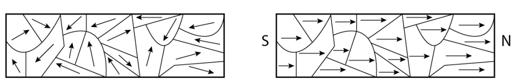
Monopoles

- A monopole is an isolated north or south pole
  - Predicted by modern theories of particle physics but have never been found

Domain Theory

- The domain theory of magnetism explains what happens inside materials when magnetized.
- All large magnets are made up of smaller magnetic regions, or domains.
- The magnetic character of domains comes from the presence of even smaller units, called dipoles.

- In most materials the dipoles are arranged randomly canceling each other out resulting in no magnetic field.
- If the dipoles all align with the poles in the same direction, then an overall magnetic field is produced.



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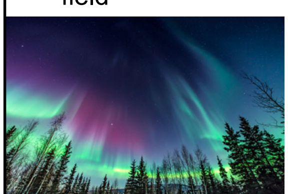
Auroras

- Caused by high-energy particles from the solar wind trapped in the Earth's magnetic field



Alaska

Australia

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