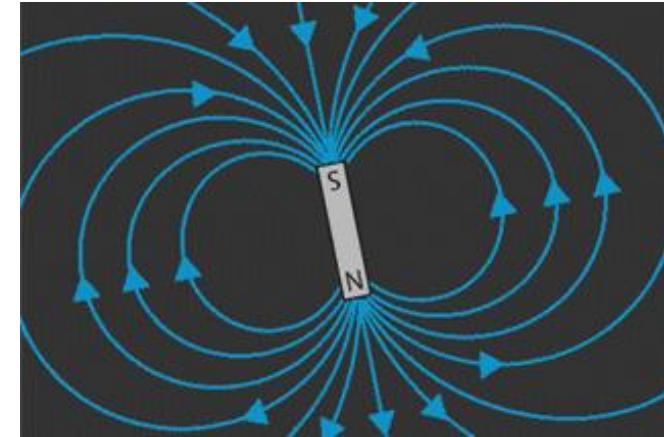
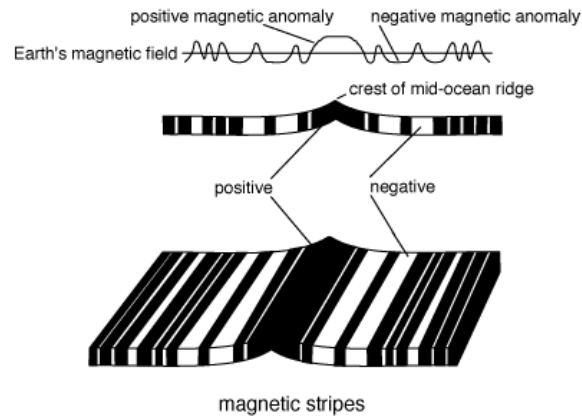
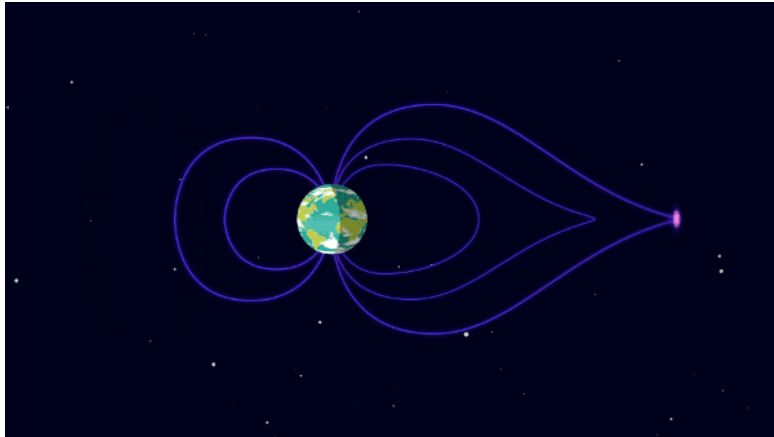


Magnetic Field



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What is Earth's Magnetic Field?

- ❖ Earth's magnetic field, also known as the **geomagnetic field**, is generated in the planet's interior and extends into space, creating a region called the **magnetosphere** and interacting with the solar wind.
- ❖ The magnetic field is generated by convection currents of molten iron and nickel in the **Earth's core**, which carry charged particles and generate magnetic fields.
- ❖ **Magnetosphere**: The geomagnetic field is the cause of the formation of the magnetosphere around the Earth. A region of space influenced by a celestial body's magnetic field. **Function**: Traps charged particles from solar winds and channels them into plasma.
- ❖ **Spread**: It extends up to 60,000 km on the side facing the Sun and to a greater extent on the opposite side.
- ❖ Its boundary is known as Magnetopause, outside which is a turbulent magnetic region known as **magneto-sheath**.

Geodynamo Process:

- ❖ Earth's magnetic field is generated by the **geodynamo process** in the outer core.
- ❖ The convective energy from the **slow-moving molten iron in the outer core** is converted to electrical and magnetic energy, inducing a positive feedback loop.

Magnetic poles:

- Earth has two sets of poles: the geographic poles and the magnetic poles.
- The **geographic North and South poles** are the locations where the **lines of longitude converge**, with the Geographic North Pole situated in the middle of the Arctic Ocean and the Geographic South Pole located in Antarctica.

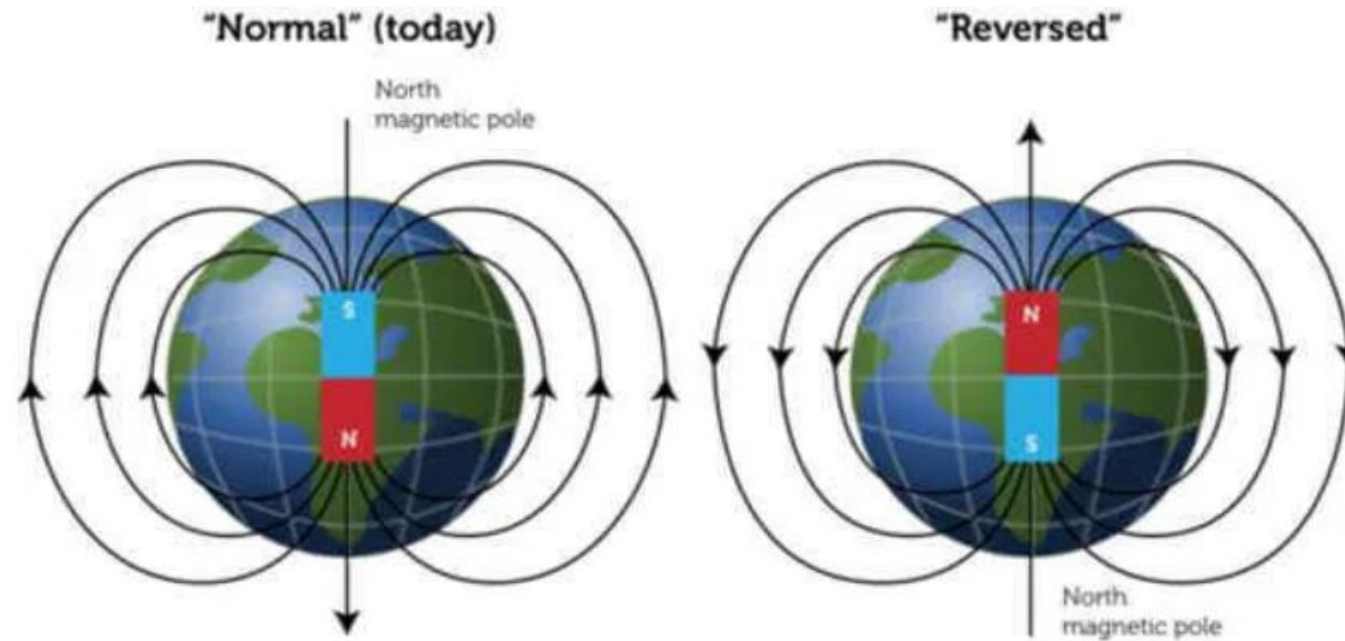
In contrast, the **magnetic poles are the locations where the magnetic field lines enter and exit the Earth's surface.**

- ❖ The Magnetic North Pole, also known as the **North Dip Pole**, is currently found on **Ellesmere Island in northern Canada.**
- ❖ When a compass points north, it is **aligning itself with the Earth's magnetic field and pointing towards the Magnetic North Pole**, not the true Geographic North Pole.

- ❖ **Navigation:** Helps in **navigation** by using the compass.
 - ❖ **Magneto-Perception:** Some **animals** can use this magnetic field to navigate while migrating over long distances.
 - ❖ **Palaeomagnetism:** The study of palaeomagnetism provides us with information about the past record of geomagnetism and the age of rocks on the surface of the planet. It also helped in developing the theories of **Seafloor Spreading and Plate Tectonics.**
- “Magnetic Pole reversal”** The forces that generate Earth’s magnetic field are constantly changing, causing changes in the strength of the magnetic field. This causes the location of Earth’s magnetic north and south poles to gradually shift, and to even completely flip locations around every 300,000 years. During a pole reversal, the magnetic field weakens but doesn’t completely disappear.

Normal and Reversed Field

- The Earth's field has alternated between periods of **normal polarity**, in which the predominant direction of the field was the same as the present direction, and reverse polarity, in which it was the opposite.



Normal and Reversed field (The bar magnet at the centre represents earth's magnetic field)

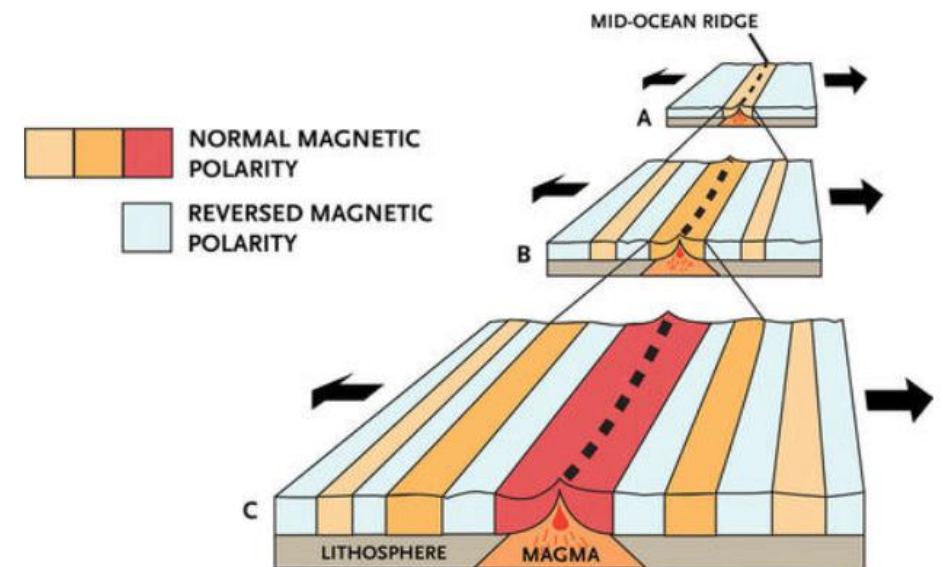
In Normal Polarity, Earth's North Magnetic Pole is the South Pole of its Magnetic Field.

In Reverse Polarity, Earth's North Magnetic Pole is the North Pole of its Magnetic Field.

Magnetic Stripes

Scientists were even more surprised to discover a pattern of magnetism on the seafloor. There are stripes with different magnetism. Some stripes have normal polarity and some have reversed polarity. These stripes surround the mid-ocean ridges. There is one long stripe with normal magnetism at the top of the ridge. Next to that stripe are two long stripes with reversed magnetism. One is on either side of the normal stripe. Next come two normal stripes and then two reversed stripes, and so on across the ocean floor. The magnetic stripes end abruptly at the edges of continents. Sometimes the stripes end at a deep sea trenches

A magnetic anomaly is a *local deviation from the expected or normal magnetic field of the Earth*. These deviations are caused by variations in the magnetic properties of rocks in the Earth's crust. Magnetic anomalies are measured using magnetometers and are used by geophysicists to investigate subsurface structures, find mineral deposits, and understand plate tectonics



- **Protection from Space Weather:**

- Earth's magnetosphere shields the planet from harmful space weather, such as **solar wind, coronal mass ejections (CMEs)**, and **cosmic rays**.
- The magnetosphere repels harmful energy away from Earth and traps it in zones called the **Van Allen radiation belts**.

- **Geomagnetic Storms and Auroras:**

- During strong space weather events, Earth's magnetic field can be disturbed, leading to geomagnetic storms that can cause power blackouts and communication disruptions.
- Disturbances in Earth's magnetic field also funnel ions towards the polar regions, creating spectacular **auroras** (northern lights and southern lights).

Thank You