

**Welcome to the Exciting
world of Earth Sciences**

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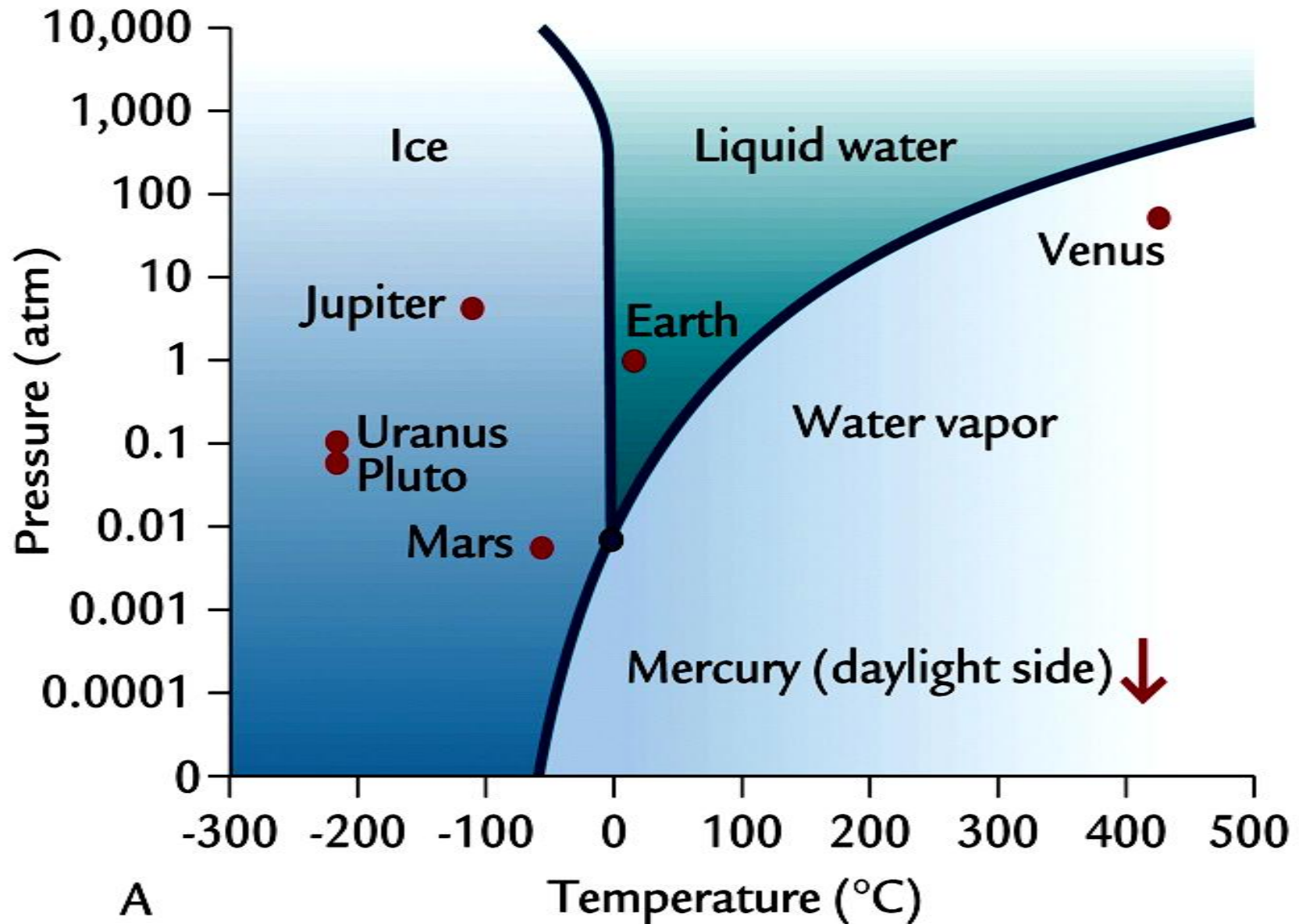
ES-1101

At IISER-Kolkata

- **Earth is a unique place,
home to millions of
organisms**

The Earth- a unique planet

Why unique?



Climates on three planets today



Venus

avg. temp. 460 °C

Earth

15 °C

Mars

-55 °C

What is Earth Science ?

To know about the origin of the Earth, how it formed, how it evolved, how it works, and **how to sustain it for the generations to come**

- **Requires broad knowledge of
Physics, Chemistry, Biology
and Maths**

**Geology + Physics=
Geophysics**

**Geology + Chemistry=
Geochemistry**

**Geology + Biology=
Geobiology....**

- **Observational, Theoretical,
Experimental & Applied
Science**
- **Basic requirement of an Earth
Scientist: Must be a Nature
Lover; Must be Adventurous;
Must be intrigued with natural
phenomena and so seek
answers**

Earth System Science

We look at the Earth as a System

It has several components that

Interact internally with each other

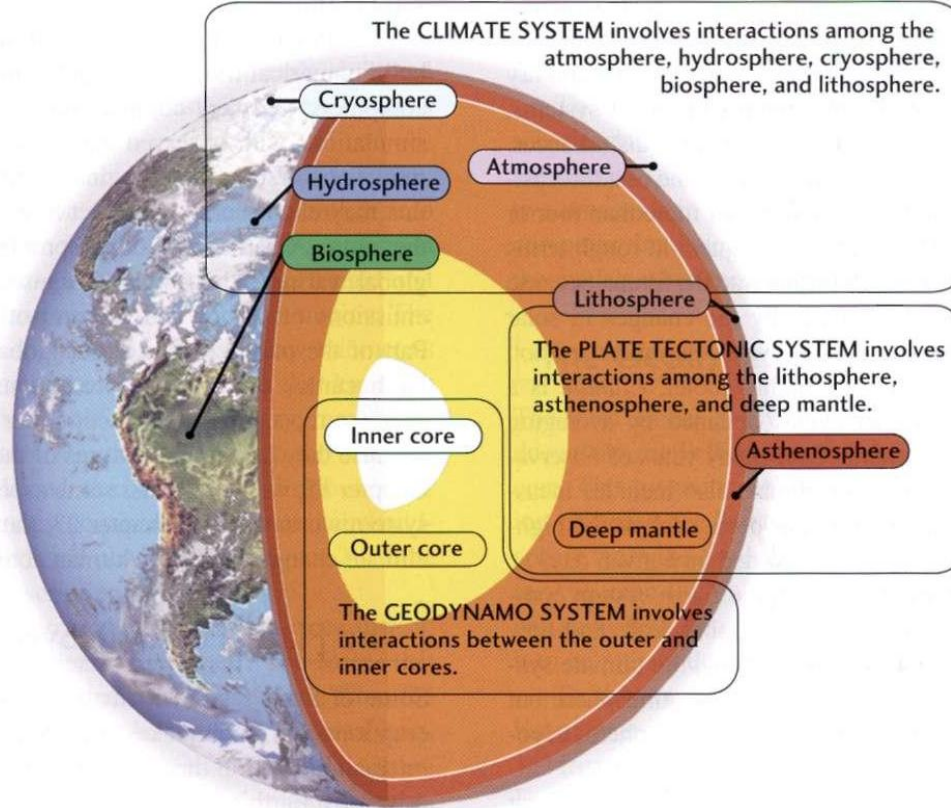
Geosphere OR Lithosphere:

Hard part, rocks, soil

Hydrosphere: oceans, rivers

Atmosphere

Biosphere & Cryosphere



Solar Radiation Energizes These Components

Atmosphere	Gaseous envelope extending from Earth's surface to an altitude of about 100 km
Hydrosphere	Surface waters comprising all oceans, lakes, rivers, and groundwaters
Cryosphere	Polar ice caps, glaciers, and other surface ice and snow
Biosphere	All organic matter related to life near Earth's surface

Earth's Internal Heat Energizes These Components

Lithosphere	Strong, rocky outer shell of the solid Earth that comprises the crust and uppermost mantle down to an average depth of about 100 km; forms the tectonic plates
Asthenosphere	Weak, ductile layer of mantle beneath the lithosphere that deforms to accommodate the horizontal and vertical motions of plate tectonics
Deep mantle	Mantle beneath the asthenosphere, extending from about 400 km deep to the core-mantle boundary (about 2900 km deep)
Outer core	Liquid shell composed primarily of molten iron, extending from about 2900 km to 5150 km in depth
Inner core	Inner sphere composed primarily of solid iron, extending from about 5150 km deep to Earth's center at 6370 km

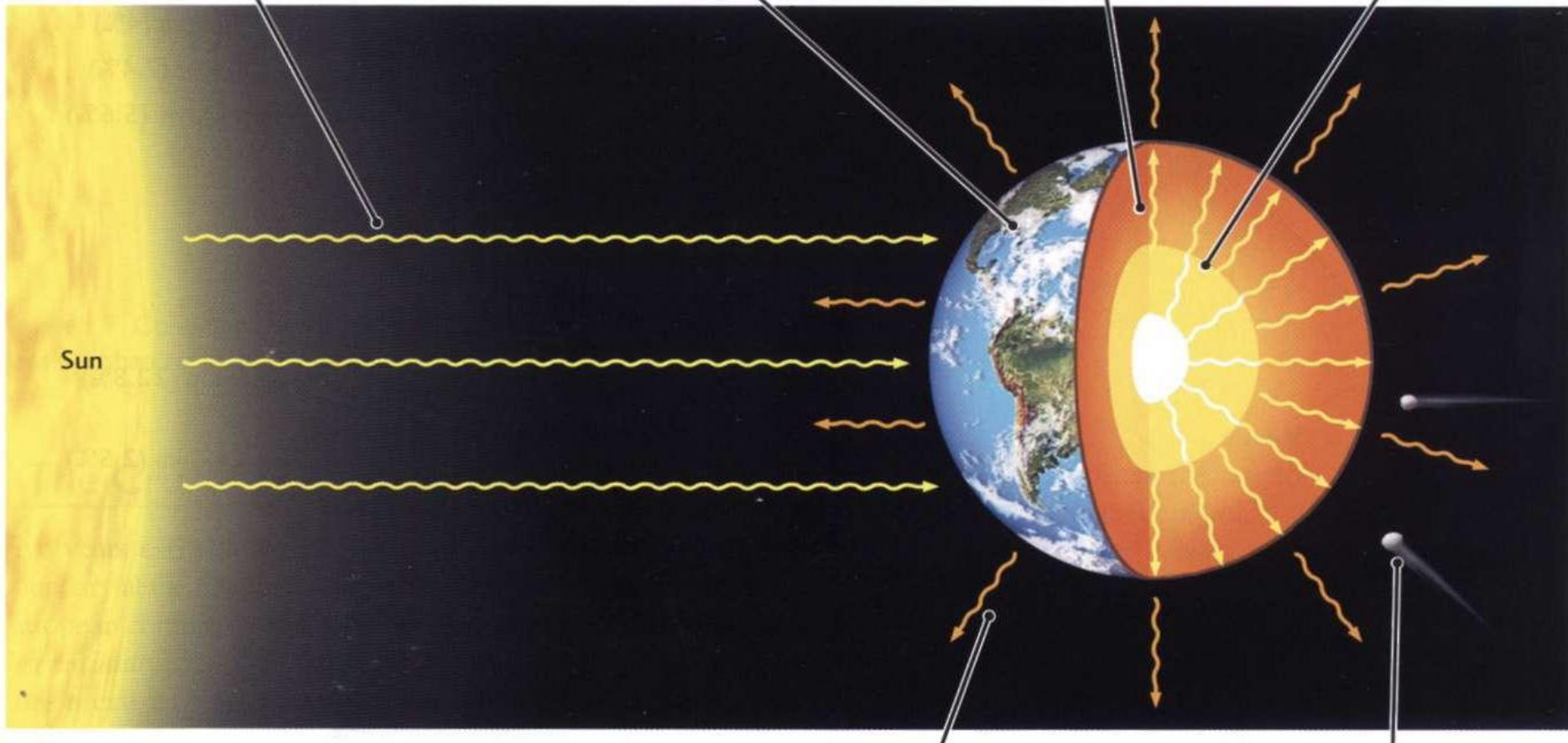
The Earth as an interacting system

1 The Sun drives Earth's external engine.

2 Solar energy is responsible for our climate and weather.

3 Earth's internal engine is powered by heat trapped during its origin...

4 ...and radioactivity in its interior.



5 Heat radiating from Earth balances solar input and heat from interior

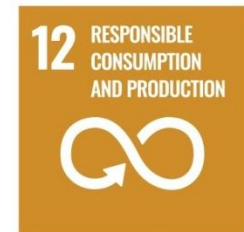
6 Meteors move mass from the cosmos to Earth

Why is it necessary to study Earth Science ?

- Let us start with a very general statement about why humanity is concerned
 - **Paris Accord 2015**
 - **Zero emission by 2050**
- **Sustainable Development Goals (SDGs) by 2030**

sustainabledevelopment

SUSTAINABLE DEVELOPMENT GOALS



Why is it necessary to study

1. Earth Science is critically relevant to human existence

The 21st century is defined by grand challenges, such as climate change and the availability of water and energy resources. Understanding the ideas and concepts Of Earth Science is critical for the ability of human society to respond successfully to these challenges and thrive in the decades to come.

Major practical issues related to Earth Science that affect our life and National growth

1. Climate change
2. Natural hazard
3. Availability of water
4. Energy requirements
5. Raw materials for industry

2. The process of Earth Science takes many different forms

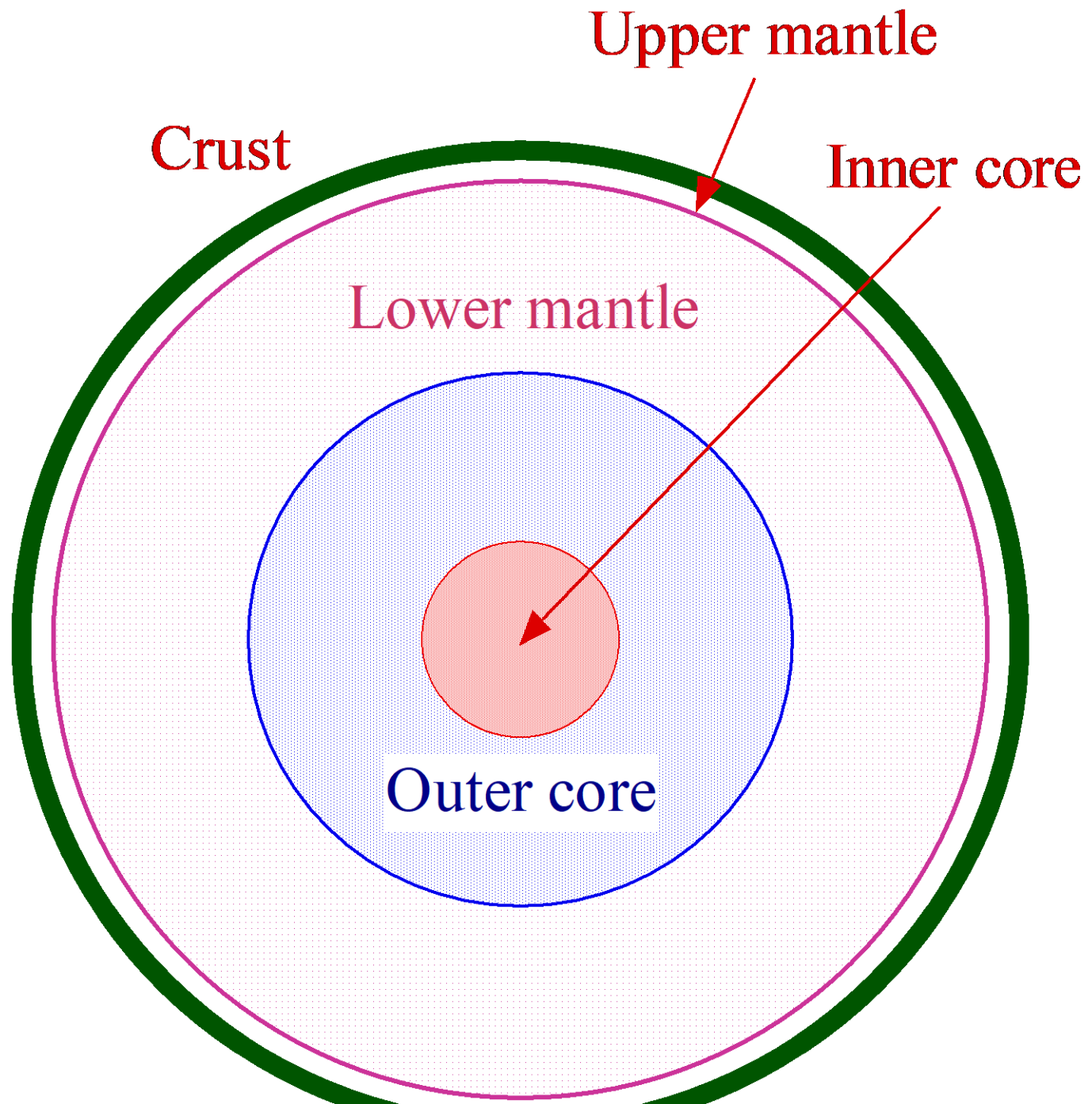
Earth Scientists use multiple lines of evidence taken from field, analytical, theoretical, experimental and modeling studies to interpret observations about Earth and forecast Earth's future

3. Earth Science research studies an enormous range of complex processes

Earth Science examines processes that occur over spatial scales ranging from subatomic to planetary and over time scales ranging from nearly instantaneous to gradual over billions of years.

4. Most of Earth's interior is inaccessible to direct observation

Earth Scientists must use complex remote methods to examine the structure, Composition and dynamics of Earth's interior. These investigations include data from Seismic waves, gravitational and magnetic fields, radar, sonar and laboratory Experiments on the behavior of materials at high pressures.



5. Earth Scientists use multiple methods to reconstruct Earth's incomplete historical records

Earth Scientists determine the history of rocks by examining their structures, fabrics, textures, compositions and mineral grain sizes.

6. Earth Scientists reconstruct the history of life and of the planet from fossil evidence

7. Earth Scientists devise methods to locate mineral deposits that produce metals/non-metals, locate coal, petroleum and nuclear fuels crucial for sustenance of human civilization

8. Earth Scientists explore the space to know about planetary evolution