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## EOSC 110 – Gravity and Magnetics Activity

For today's activity you will be working in groups of four as we explore the gravity and magnetics of the planets in our solar system and what that can tell us about their interiors and plate tectonic activity.

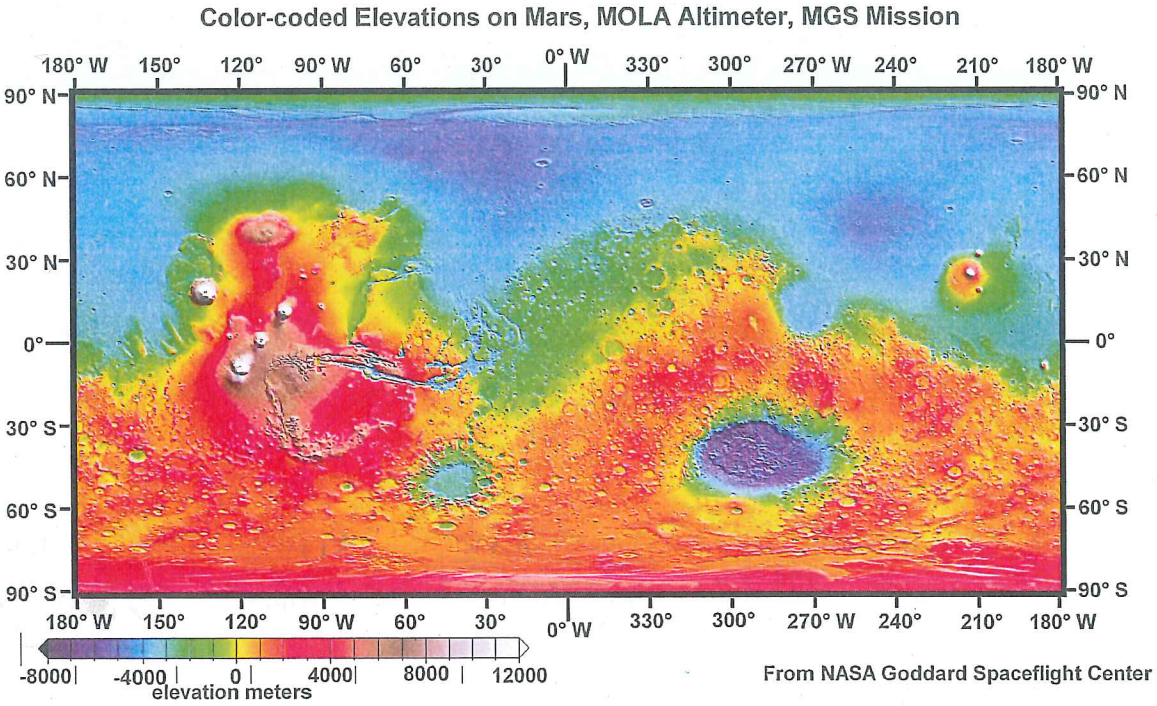
**Learning Goal**

Compare and contrast the Earth's gravity and magnetic field with those of other planets in the solar system

### Activity 1: Gravity

Using your knowledge of the Earth's gravity anomalies (the way gravity varies in different places over the surface of the Earth from your lecture notes), take a look at the topography and gravity maps of our two nearest neighbours and see how they compare to the Earth.

**MARS - topography**



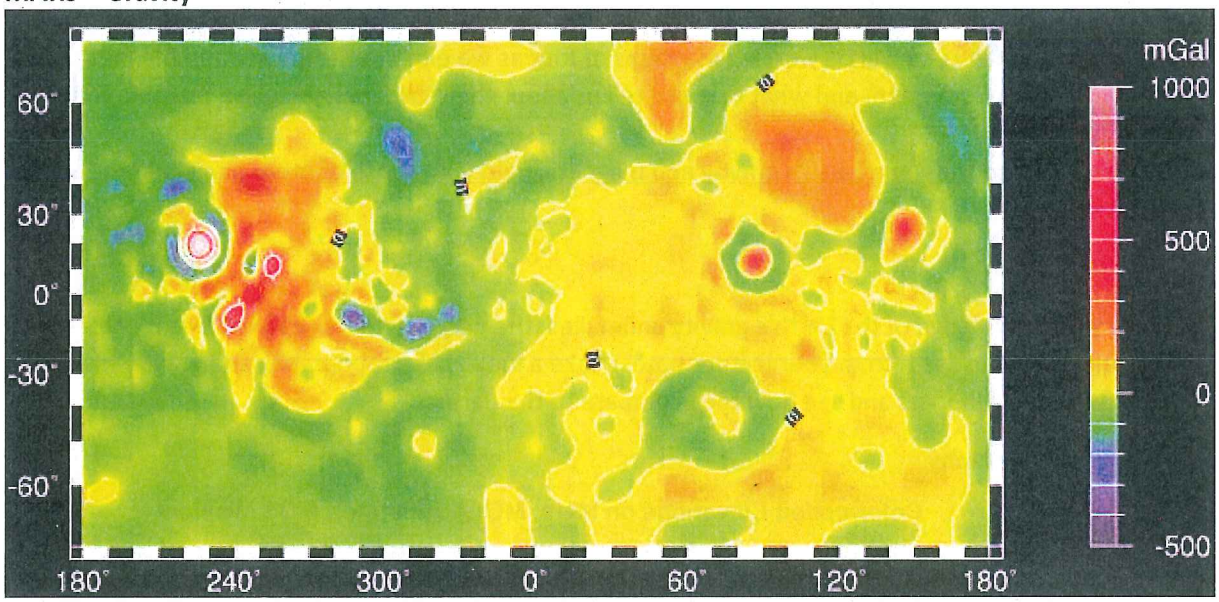

What is the range of topography on Mars? -8000m ~ 12000m

Does it have a higher range than the Earth? Yes.

Earth: -6000 ~ 6000.

How would you describe the pattern of topography? The southern part has higher topography than the northern part

**MARS – Gravity**




What is the range of gravity anomalies? -500 mGal ~ 1000 mGal.

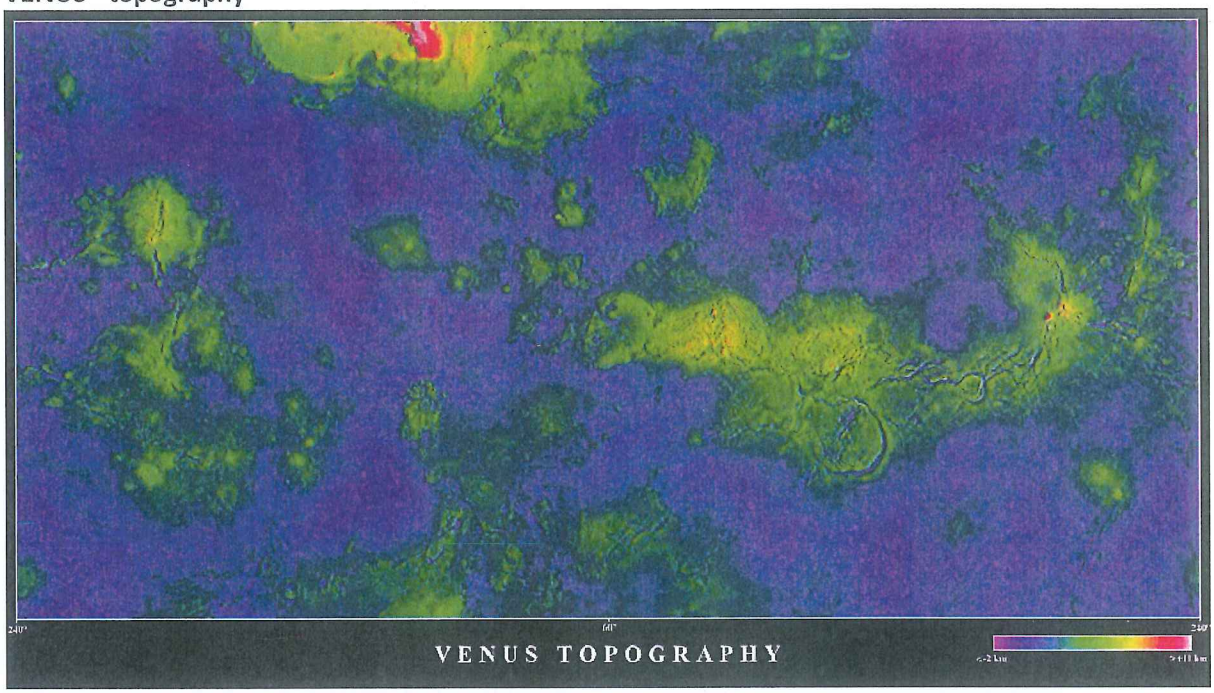
How would you describe the patterns? the middle western part has bigger gravity.

Does the gravity correlate with the topography? maybe, because the middle western has both higher topography and bigger gravity

How is this different to the gravity anomalies we see on Earth?

the range is different + bigger gravity at the equator.

VENUS - topography



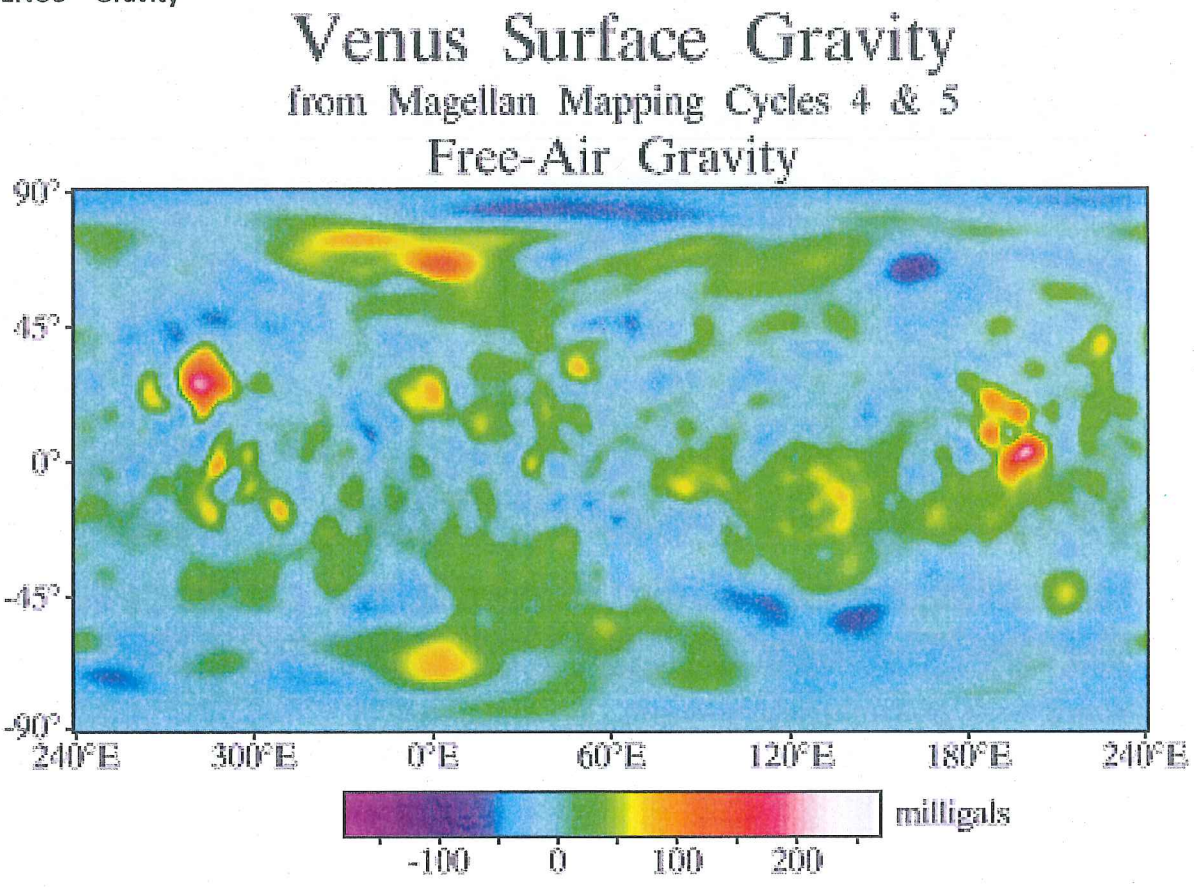

What is the range of topography on Venus? 2km ~ 411 km.

Does it have a higher range than the Earth? No

How would you describe the pattern of topography?

Highest topography at the northern part and mostly high(midium) topography at the equator & edge.

VENUS – Gravity




What is the range of gravity anomalies? -200 ~ 300 milligals

How would you describe the patterns? high gravity at the edge (toward)

Does the gravity correlate with the topography?

Both high (medium) topography & gravity at the edge and the equator.

How is this different to the gravity anomalies we see on Earth?

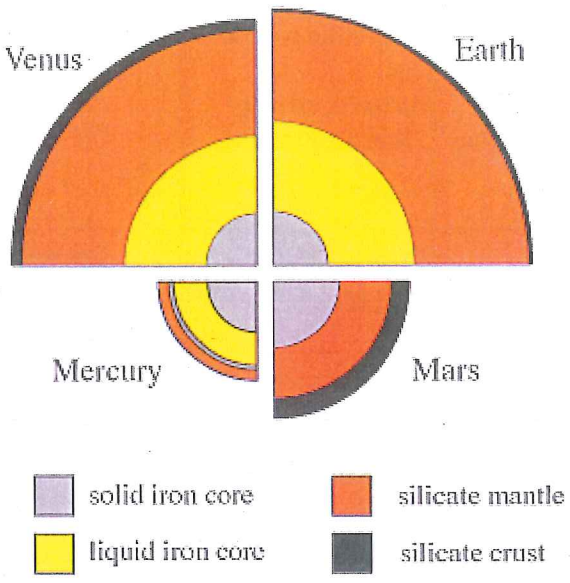
Smaller gravity than the Earth.

## Activity 2: Earth's Magnetic Field

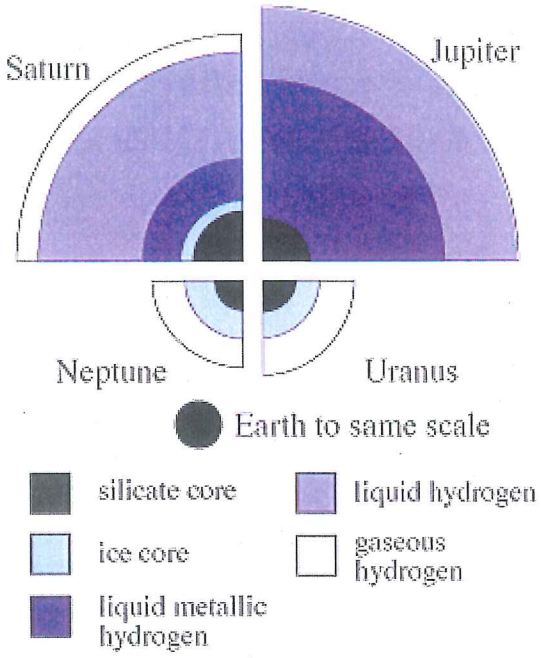
Luckily for us the Earth has a strong magnetic field, so it not only helps us to navigate and to understand the movements of the lithospheric plates through the study of palaeomagnetism, it protects us from the solar wind and cosmic rays which would otherwise strip away our atmosphere exposing us to harmful radiation.

There are a few essential things that are thought to be needed to generate a magnetic field in the **Geodynamo Theory,** use this information, the internet, and the pictures below to fill in the table on the next page:

1) The outer core must be a liquid and electrically conductive
2) There must be a large thermal gradient between the inner and outer core and a large thermal gradient between the outer core and mantle. This causes 'fast' convection in the inner core.
3) The rotation of the planet needs to be fast enough that the fluid motion is channelled into rolls oriented along the rotational axis by the Coriolis force.




Terrestrial planet interiors to same scale




Jovian planets interiors to same scale

**Activity 2: Magnetic Fields of Other Planets**

Using your knowledge of how and why the Earth's magnetic field is generated what can you deduce about the differences between our magnetic field and that of some of the other planets in the solar system? Complete the table below using your Planets notes (the diagrams showing the interiors of the planets on the previous page may be useful) and the internet.

| Planet | Magnetic Field | Core composition? Is there any fluid in the interior? | Planet diameter/heat loss mechanism | Rotation rate and rotation axis | Why is it different than the Earth? |
|---|---|---|---|---|---|
| Mercury | Very weak | Metallic core - outer core liquid | 4,879km solid part; conduct liquid; convect | 58.647 days 10.892 km/h Every N-S axis; counter clock rotation | Small M.f. & No liquid outer core |
| Venus | None | metallic core - outer core liquid | 12,104 km blob tectonics Conduction | 6.5km/h clockwise | the rotation slow backward |
| Earth | Strong | Metallic core – outer core liquid | 12,742 km Active plate tectonics – steady heat loss, convecting inner core and mantle | 1 rotation per 24 hrs N-S axis, counter clockwise rotation | N/A |
| Mars | Weak | Solid iron, | 6,779 km lithosperic | 24hr 37' 22" Counterclockwise | No liquid outer core & Solid → weak magnetic field |
| Jupiter | Strong and large (extensive) | Silicate, liquid metallic hydrogen. | 139,822 km Advection. | 9.8hr. counter clockwise | huge magnetic field → strong magnetic field |
| Saturn | Strong and large (extensive) | Silicate, ice, liquid metallic hydrogen. | 116,464 km thermal. | 10 hr 42' counterclockwise | huge liquid outer core |
| Uranus | Asymmetric and tilted from rotation axis | Silicate, ice. | 50,724 km | 17hr 14min. counterclockwise | No liquid outer core |
| Neptune | Complex and tilted from rotation axis | silicate, ice. | 49,244km. conduction, convection, radiation | 1hr 6' counterclockwise | " |