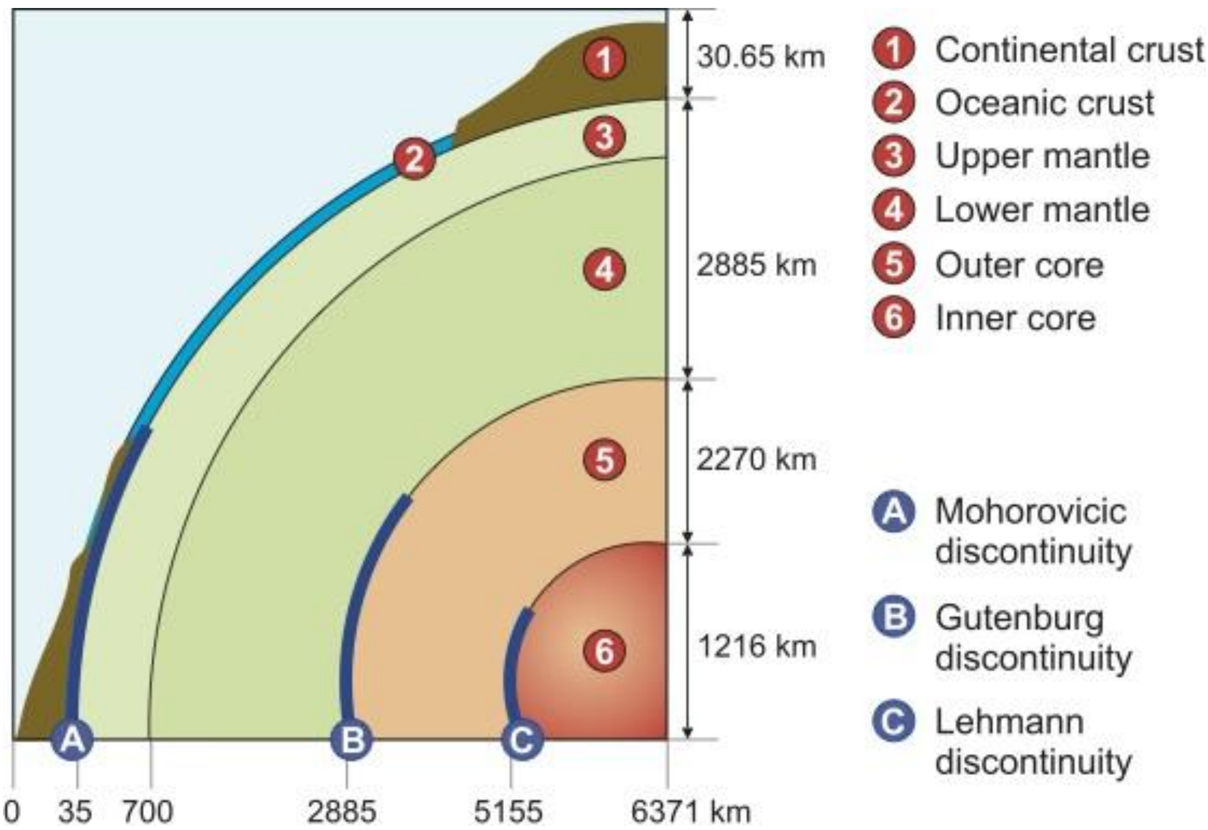
GIC & Rock Density – Teacher Notes

After the first three billion years, it is thought that Planet Earth had differentiated into a nickel-iron core, a mantle and a silicate rich crust, by density sorting whilst it was mostly molten. The planet was hotter than at present because heat generated by gravitational collapse of the solar dust disc had not yet been radiated into space. Presently our planet is primarily heated by natural radioactive decay. The process of density sorting is called planetary differentiation or "**The Great Iron Catastrophe**". The word catastrophe is used in drama to describe the final scenes in an Ancient Greek play when everything is sorted out.



Schematic view of the Earth's interior (Tompkins, 2010)

The crust itself consists of two layers

1. **Continental crust** that has a low density and is mostly made of sedimentary rocks such as sandstone overlying silica rich (felsic) igneous rocks such as granite.
2. **Oceanic crust** which is denser and made of silica poor mafic igneous rocks such as basalt.

Hypothesis: Rocks from oceanic crust are denser than those from continental crust.

If we want to support this hypothesis with data we can easily access rocks of the continental crust under our feet. They are rich in silica and examples would be sediments such as sandstone, limestone and mudstone or silica rich igneous rocks such as granite and rhyolite. All continents and continental shelves are made of this material.

The continental crust "floats" on denser iron and magnesium rich oceanic crust. Specimens from oceanic crust however can only be collected when volcanism brings rocks such as basalts and peridotites from oceanic crust and upper mantle to form islands or massive outpourings (flood basalts) during major tectonic events.

Rarely, when slabs of oceanic crust are thrust over continental crust, we can sample ophiolites. Slabs of ophiolites can be found in New Zealand and Tasmania.

Information from dense nickel iron meteorite fragments which may be from the core material of exploded planets, is also used as proxy evidence

In Year 8 students should have classified igneous rocks into less dense felsic (light in colour and silica rich) and mafic (dark in colour and magnesium rich) rocks.

Density averages for the spheres of our planet

Location on planet	Density (g/cm^3)
All Earth	5.45
Continental crust	2.7 – 3.0
Oceanic crust	3.0 – 3.3
Upper mantle	3.3 – 5.7 increasing with depth
Outer core	9.9 – 12.2
Inner core	12.6 – 13.0

Students will need a variety of continental crust specimens (sandstone, limestone, mudstone, coal and granite) to compare with specimens of oceanic crust (basalt, gabbro and peridotite). If the school does not have specimens then a table of densities of Western Australian rocks is attached

AIM To measure and compare the density of rocks from oceanic crust and continental crust

1. Discuss with your group and decide what equipment to order. Triple beam balances or equivalent, beakers or displacement cans, measuring cylinders. Size of each rock is a consideration when selecting beakers or cans. Perhaps calculators
2. Order the equipment necessary to estimate the mass, volume and therefore density of each rock. An order sheet is attached.
   (Ensure that this equipment will give readings to two decimal places)
3. Measure the mass and volume of each rock selected by your teacher
4. Enter the figures in the data sheet provided.
5. Calculate the density of each rock **(Mass ÷ Volume = Density)**

Materials

GIC & Rock Density – Teacher Notes

Observations

Rock	Mass (g)	Volume (cm^3)	Density g/cm^3
1			
2			
3			
4			
5			
6			

Conclusion

Discussion

Is this primary data or secondary data?

Primary data because I measured it myself for this specific purpose.

Using this data and the secondary data sheet below assign a location for the origin of each rock within the planet Earth.

Western Australian rock information

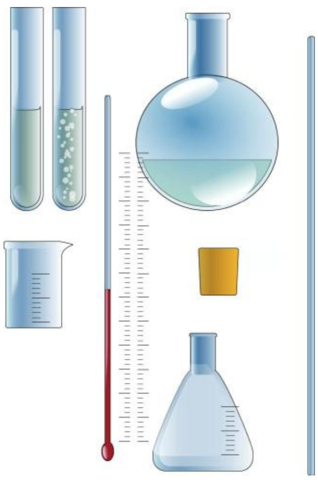
Rock Name	Possible source in WA	Density g/cm^3	Origin in planet
Basalt	Bunbury beach	3.00	Continental crust/Oceanic crust
Coal	Collie Mingenew	1.25	Continental crust
Diorite	Mt Bruce	2.95	Continental/upper oceanic crust
Dolomitic limestone	Hamersley Gorge	2.80	Continental crust
Gabbro	Windimurra	3.15	Oceanic crust
Gold	Kalgoorlie	19.32	Core
Lead ore (galena)	Northampton	6.23	Outer core
Gneiss	Dunsborough	2.82	Continental crust
Granite	Yilgarn	2.75	Continental crust

GIC & Rock Density – Teacher Notes

Limestone	Coastal WA	2.32	Continental crust
Marble		2.50	Continental crust
Mica schist	Bindoon	2.90	Continental crust
Nickel sulphides	Kambalda	8.13	Core
Peridotite	Argyle	3.40	Upper mantle
Quartzite	Jigalong	2.75	Continental crust
Rhyolite	Near Newman	2.55	Continental crust
Sandstone	Broome	2.55	Continental crust
Shale	Canning basin	2.45	Continental crust
Slate	Whim Creek	2.70	Continental crust
Student rock			
Student rock			
Student rock			
Student rock			

Why do most of our specimens come from continental crust? Land is mostly continental crust.

Laboratory equipment order sheet



Group names ______________________________

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Room Number ______________________________

Teacher ______________________________

Date required ______________________________

Materials requested

Date requested

Please give name of equipment and size

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GIC & Rock Density – Teacher Notes

A simpler inexpensive version of the rock density experiment

For schools with limited equipment or with students who have problems calculating density this simpler experiment will allow for relative estimation of density of rocks.

A plastic coat hanger can be used as a beam balance to demonstrate the relative density difference.

Rocks selected need to be of about the same size.

Materials

- Plastic coat hanger
- String
- Assorted rocks

Alternatively a plastic shopping bag can be attached to each end of the coat hanger and used like balance pans to contain equal volumes of different rock specimens. This is easier if you are using broken pea gravel, pieces of concrete, calcrete or road metal.

If you are using a wire coat hanger, wrap masking tape round the arms to form bumps to retain the string or plastic bag handles.

The rock on the right is dense iron rich basalt from the base of oceanic crust brought to the surface by a volcano in Iceland. The rock on the left is sandstone, a sedimentary rock, from continental crust near Geraldton WA.

Although you can gain an impression of how rock density ranges, the equipment does not provide a data which is accurate (true reading) and precise (to two decimal places).