

# Earth Science in Schools – what do (or should) our students know the day they arrive

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# Earth Sciences



# Earth System Science



# Geoscience





# Reservoir Engineer







# Reservoir



# Geology



# National Curriculum For Science

- Introduced (England & Wales) 1989
- Latest version 2008
- Earth science component new to many teachers



# Key Stage 3 PoS

- **3.4 The environment, Earth and universe**
- **a** geological activity is caused by chemical and physical processes
- **b** astronomy and space science provide insight into the nature and observed motions of the sun, moon, stars, planets and other celestial bodies
- **c** human activity and natural processes can lead to changes in the environment.

- [www.qcda.gov.uk/curriculum/](http://www.qcda.gov.uk/curriculum/)

# Key Stage 4 PoS

- **2.4 Environment, Earth and universe**

In their study of science, the following should be covered:

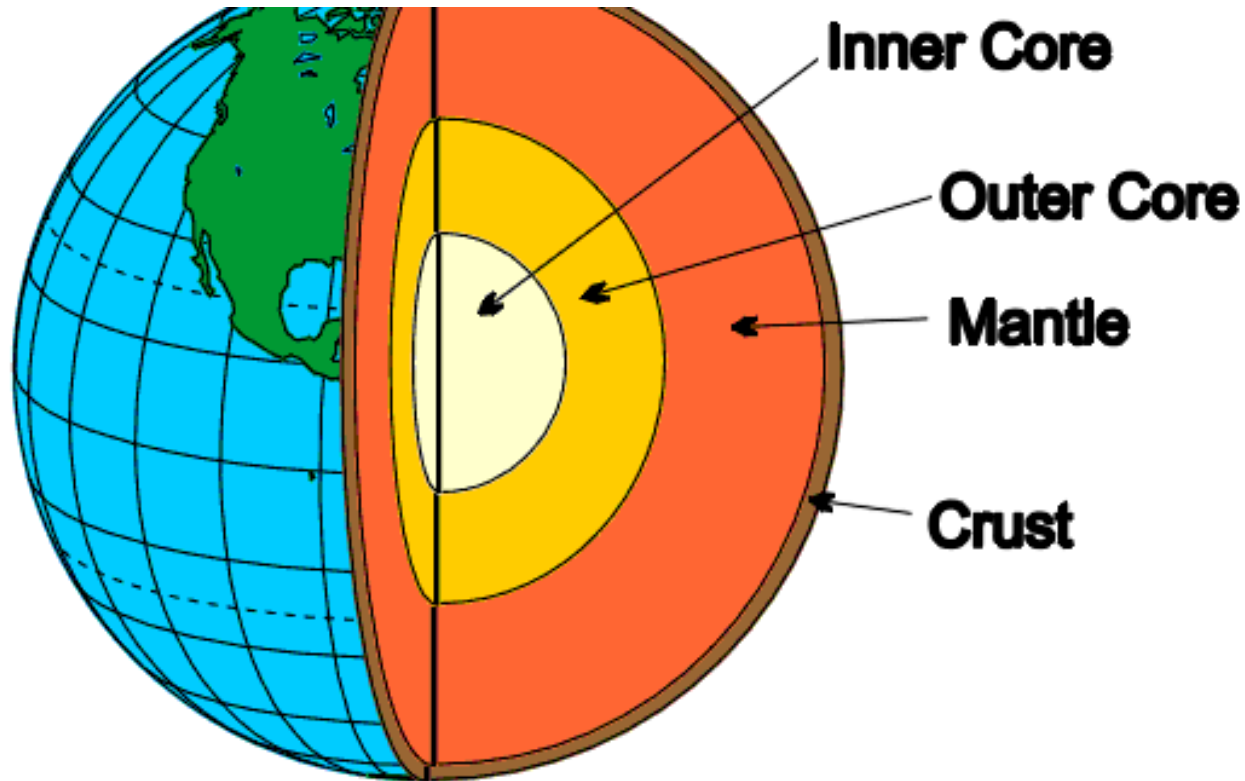
- the effects of human activity on the environment can be assessed using living and non-living indicators
- the surface and the atmosphere of the Earth have changed since the Earth's origin and are changing at present
- the solar system is part of the universe, which has changed since its origin and continues to show long-term changes.

- [www.qcda.gov.uk/curriculum/](http://www.qcda.gov.uk/curriculum/)

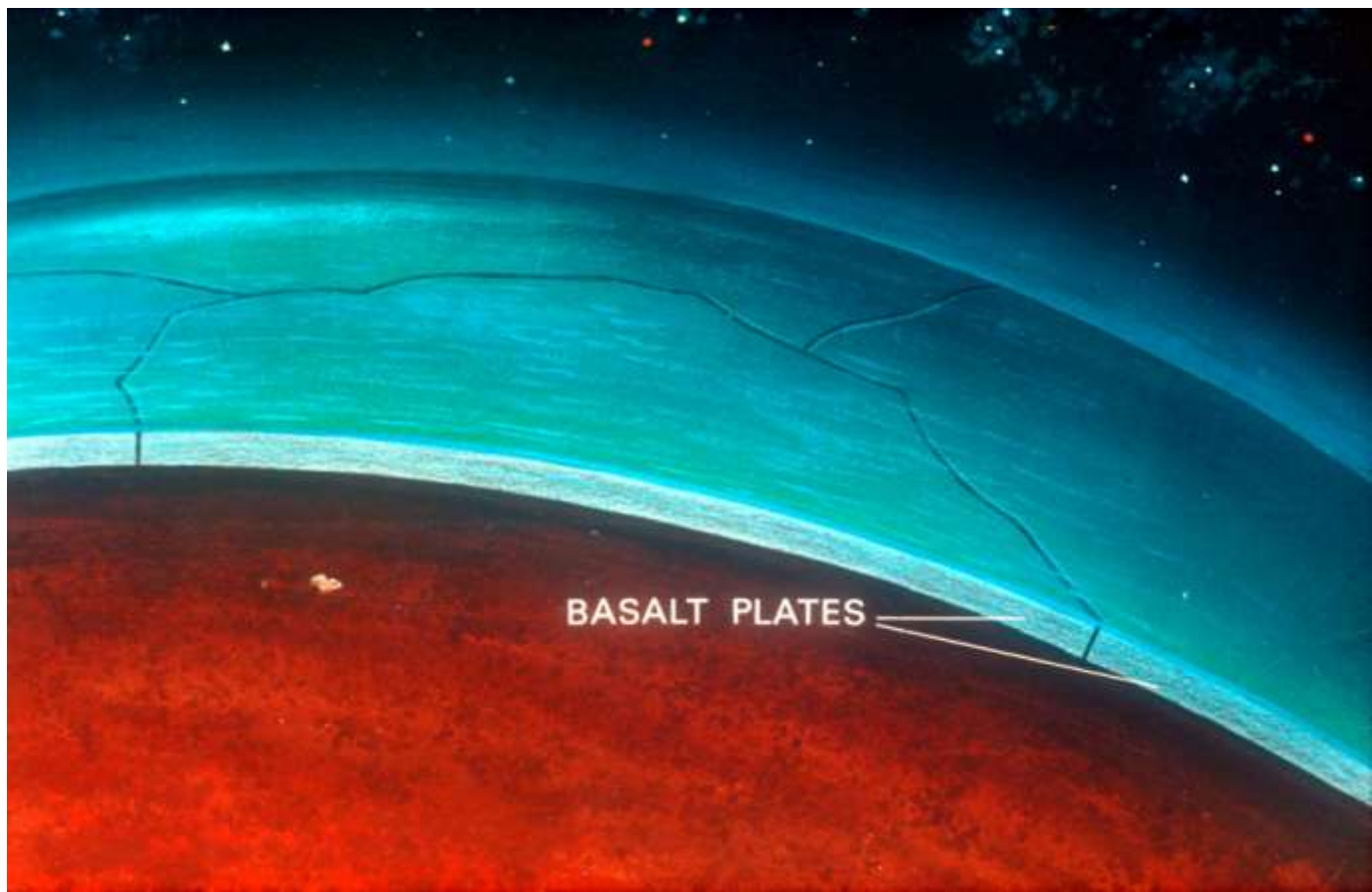
# problems

- Earth sciences largely placed in chemistry (resented by some chemistry teachers)
- Limited support material available
- What material was available of questionable quality

# The Mantle....

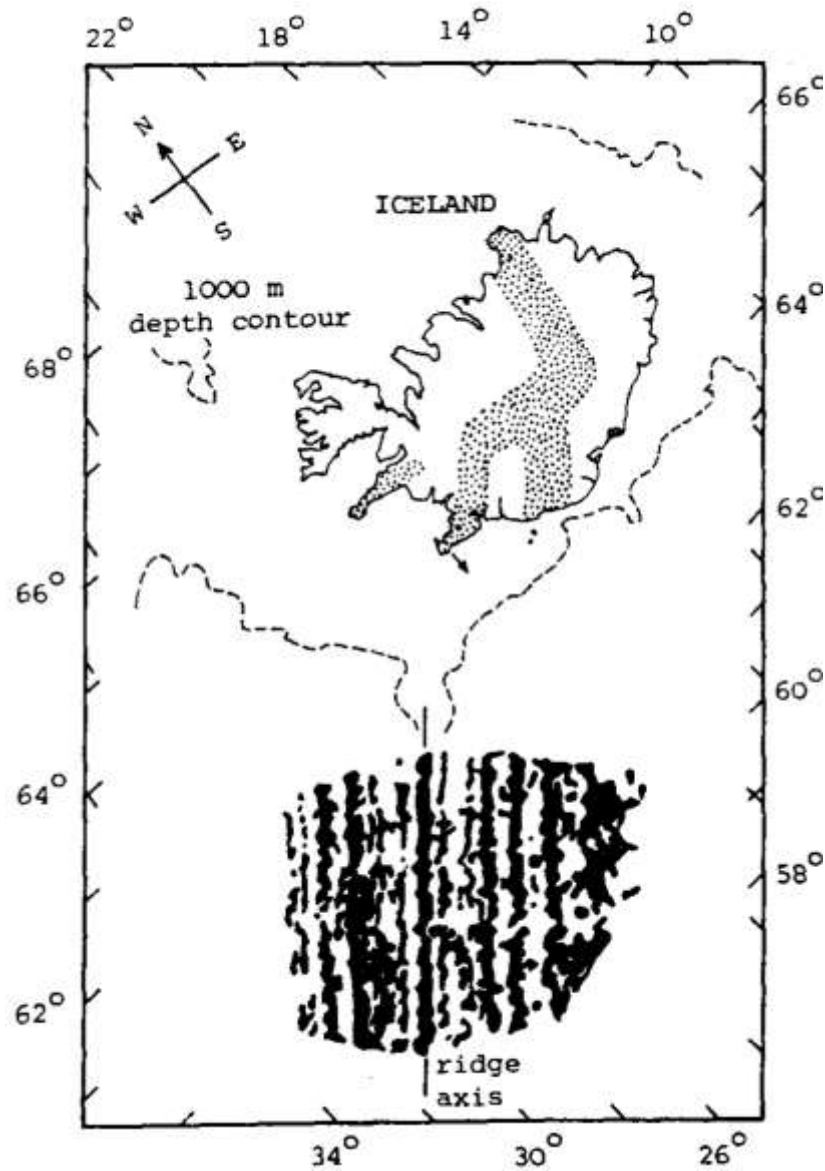


The crust is solid rock. The mantle is liquid rock ("liquid hot magma"). The outer core is liquid nickel and iron. The inner core is solid nickel and iron. The inner core is solid because while hot, there is much more pressure keeping it solid.



BASALT PLATES

# What colour is the ocean floor?





# Solutions:



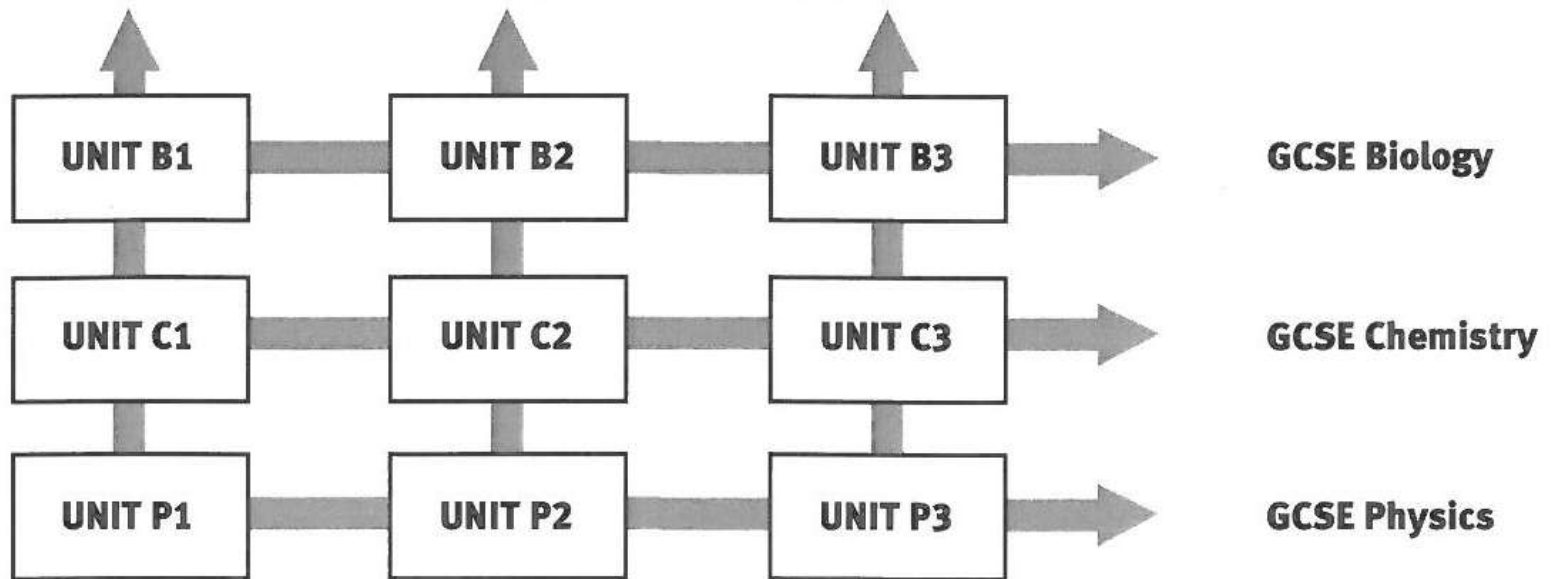
**EDUCATION  
UNIT**

## Specification design

**GCSE Science**

**GCSE Additional Science**

**Extension Units**



Kennett 2006

## Plate tectonics in the new GCSE Specifications 2007/8

Topic	Awarding Body				
	OCR: (Gateway)	OCR: (21st C)	AQA:	WJEC:	EDEXCEL
Crust, mantle, core	X	X	X	X	
Plate = crust + upper mantle	X	X	X		
Lithosphere named as such	X	X		X	
Plate density & subduction	X			X	
Convection in mantle	X		X	X	
Heat from radioactive decay	(X)		X		
Partial melting of subducting plate	X		X	X	
Rising of lower density magma	X		X	X	
Volcanoes – contrasts in lava type	X				
Prediction of volcanoes and earthquakes	X	(X)	X		X
Plate margins and volcanoes & earthquakes	X	X	X	X	
P and S seismic waves – characteristics	X			X (Ph)	X
Surface seismic waves				X (Ph)	
Evidence of Earth's Interior from P & S waves	X			X (Ph)	X
Earth's magnetic field	X				(X)
Continental drift theory	(X)	X	X		X
Shrinking apple theory			X		
Wegener named & debate at time		X		X	
Sea-floor spreading		X		X	
Magnetic patterns at oceanic ridges		X			
Rate of plate movement	X	X	X	X	
Plate tectonics and the rock cycle		X		X	

Beware! Some Awarding Bodies put Plate Tectonics in "Physics", others in "Chemistry". All Awarding Bodies cover evolution. None mention geographical isolation of species as a result of plate tectonics, but it is an important part of the story.

X = topic covered.

(X) = topic touched on only

(Ph) = covered in Physics (separate subject only)

No detailed survey of the Applied Specifications was undertaken, but a quick review showed that several of them do bring in some Earth science, mostly recapitulating the content of the GCSE Science Specifications tabulated above.

Kennett 2006

Draw a labelled diagram of the structure of the Earth using the following words:

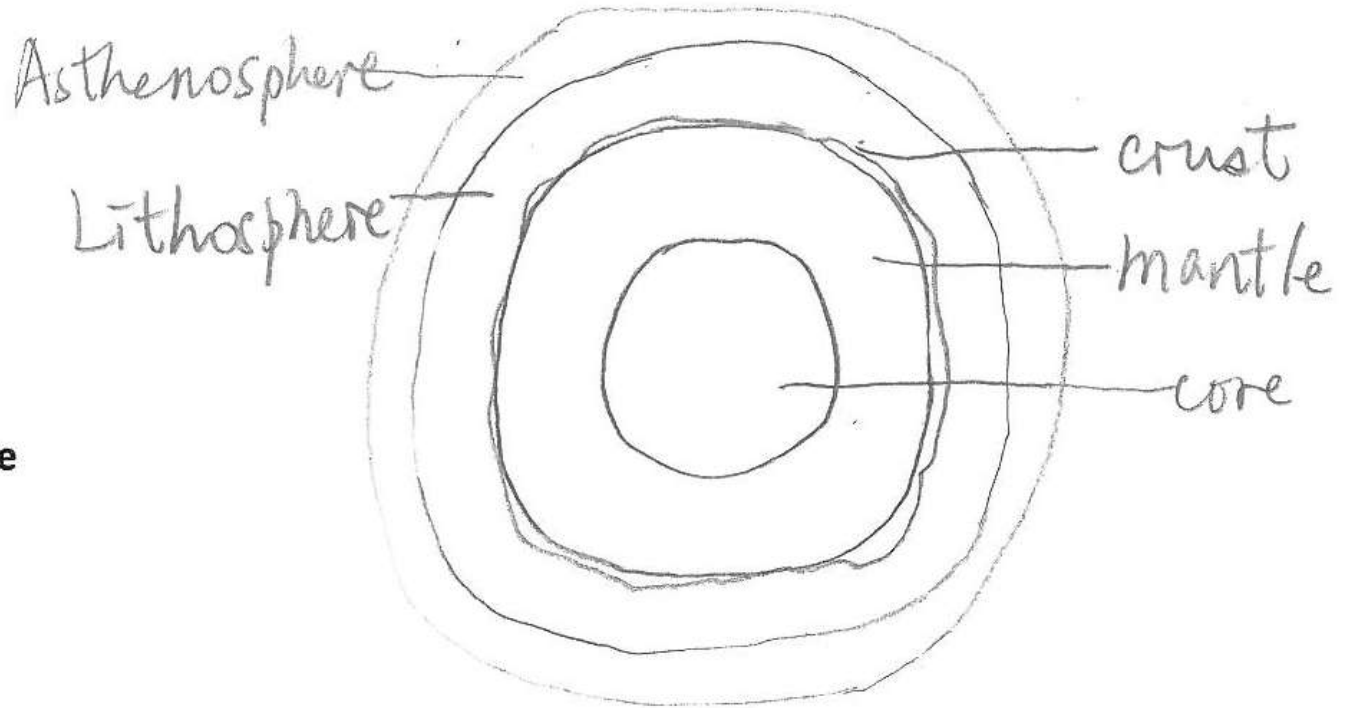
**Core**

**Mantle**

**Crust**

**Lithosphere**

**Asthenosphere**



# Deep Time

- 4.4-4.8 billion – 7
- 4 or 5 billion – 9
- 3-100,000 billion - 46

# Money!!!!

- School students are not aware of the possible remuneration of a career in Geology & Geophysics
- 103 students, year 10, rated geology below medicine, business & civil engineering for earning potential

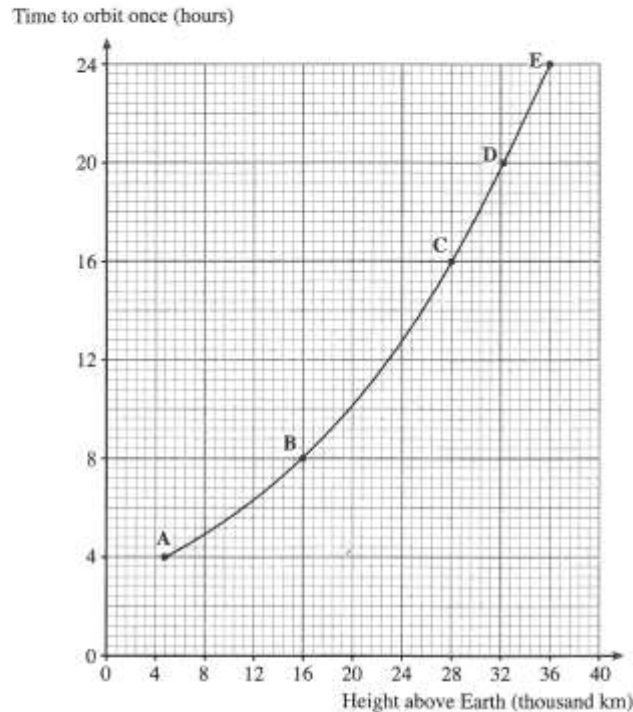


# Coursework:

- Revisit
- Revisit
- Revisit
- Revisit!

Very specific questioning:

5. Artificial (man-made) satellites are sent into orbit around the Earth to do a variety of jobs. The graph below shows how a satellite's orbit time depends on the height above the Earth.



- (a) (i) Use the graph to find the time taken for satellite B to orbit once. [1]  
 Time = ..... hours
- (ii) How many times would B orbit the Earth in one day (24h)? [1]  
 Number of times = .....
- (b) (i) Use the graph to find the height of a satellite that orbits once in 16 hours. [1]  
 Height = ..... thousand km.
- (ii) Which one of the points (A, B, C, D, or E) shows the satellite that stays above the same point on the Earth at all times? ..... [1]
- (c) State one use for artificial satellites. [1]

# GCSE changes starting 2011

OfQual-office of qualifications and examinations  
regulation (QCDA no longer exists...)

- Controlled Assessment – much tighter controls on coursework
- Modules can only be re-sat once
- At least 40% of assessment has to be in the final exam

# OCR GCSE Gateway Science Suite

## Science B (Draft)

Describe the mantle as the zone between the crust and the core which is:

- cold and rigid just below the crust
- hot and non-rigid at greater depths and therefore able to move.

Describe the theory of plate tectonics:

- energy transfer involving convection currents in the semi-rigid mantle causing the plates to move slowly

- oceanic crust more dense than continental crust

- collision between oceanic plate and continental plate leads to subduction and partial melting

- plates cooler at ocean margins so sink and pull plates down.



# CONCLUSIONS

- Have done some geology in science
- Amount (and quality) varies
- May not know it is geology
- Looks likely that the geology in science GCSE will remain on the curricula for the next few years

# Things to be a aware of...

- Schools do not owe you a living
- Exam points= prizes in schools
- Schools are much better resources than we are

# Future:

- Academies.....

Kennett P 2006. Comparisons of the New GCSE Science Specifications for their Earth Science Content. *Teaching Earth Sciences* Vol.31(2) 28-34

King C 2009. An analysis of misconceptions in science textbooks: earth science in England and Wales. *International Journal of Science Education*, 31. ISSN: 1464-5289

Murphy P J & Murphy E 2007. Student perceptions of geology as a career option. *Teaching Earth Sciences* Vol.32 (1) p22