

## Journey to the centre of the Earth – on a toilet roll Just how thin is the crust we live on?

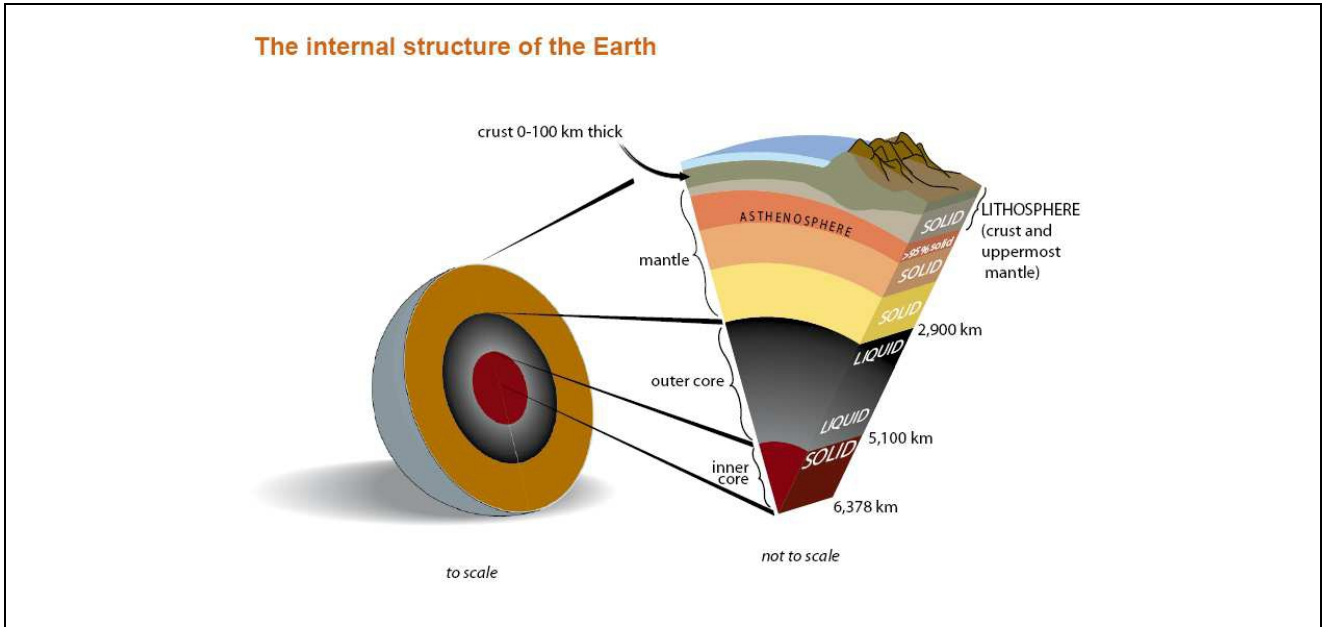


Diagram: The internal structure of the Earth (Diagram by courtesy of the Earth Science Education Unit)

Diagrams of the Earth's internal structure, like this one, are often found in school textbooks. However, although the smaller diagram is drawn to scale, it is difficult to get a feel for the real thickness of the Earth's crust. This crust, of course, provides the basis for our human existence on the planet. The enlarged diagram gives the impression that the lithosphere (the crust and upper mantle) is much, much thicker than it really is.

Use a toilet roll to make a scale 'model' of the structure of the Earth, from its surface to its centre. The Earth's average radius is about 6400 km. If one sheet of paper is taken to represent 100 km, then 64 sheets will take us to the centre of the Earth. Unroll three sheets and mark them up to represent the outermost layers of the Earth, as shown in Photograph 1.

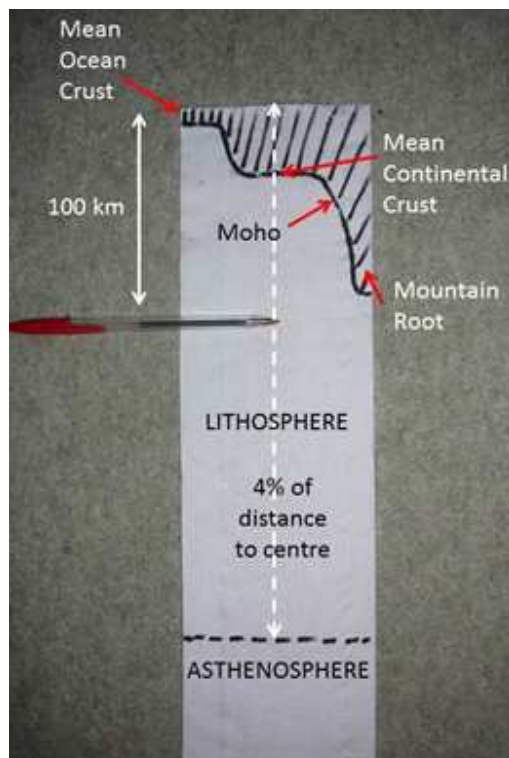


Photo 1: The top part of the toilet roll, showing the crust and lithosphere drawn to scale. The red pen marks the end of the first sheet. The base of the lithosphere is 2½ sheets down from the top.

Ask a pupil to walk away, slowly unrolling the toilet roll, whilst someone else counts down 29 sheets. Mark the boundary between the mantle and the core at the bottom of sheet 29. Continue unrolling until sheet 51 is reached and mark the boundary between the outer and inner core. Finally, unroll as far as sheet 64, and you have finished your journey to the centre of the Earth!

A different approach is to give a toilet roll to each small group of pupils and ask them to mark the boundaries for themselves. Whichever method is used, discuss the 'model' with the class and ensure that they have appreciated the true scale of the Earth's different layers?

## The back up

**Title:** Journey to the centre of the Earth – on a toilet roll

**Subtitle:** Just how thin is the crust we live on?

**Topic:** A scale model of the size of the Earth, emphasising the thinness of the crust and other uppermost layers.

**Age range of pupils:** 11 -18 years

**Time needed to complete activity:** 10 minutes

**Pupil learning outcomes:** Pupils can:

- visualise the true dimensions of the different layers of the Earth's internal structure;
- gain an idea of the size of the Earth;
- appreciate that the crust is extremely thin, in relation to the rest of the Earth.

**Context:** We seldom stop to consider the true scale of many features of the Earth. This activity aims to enable pupils to visualise the thickness of the crust in relation to the rest of the Earth. It also helps them to appreciate the difference in depth between the oceanic crust and the continental crust. It introduces the terms 'lithosphere' and 'asthenosphere' to help in understanding plate tectonic theory.

**Following up the activity:**

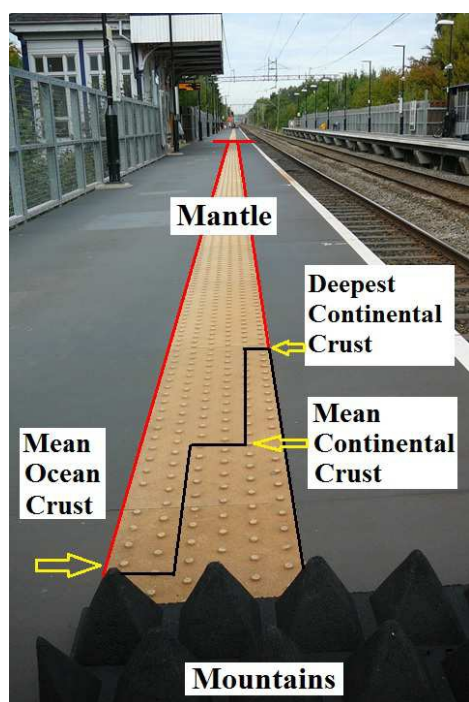


Photo 2: Paving slabs on a railway platform, with labelling superimposed to show the structure of the Earth to scale. (Photos: Pete Loader)

- Use any area round the school with regularly spaced floor patterns or paving slabs to count out a similar 'model' of the Earth. See if permission can be gained to mark the boundaries of the Earth's layers as a permanent reminder to the school.
- Use the Earthlearningidea activities, *From an orange to the whole Earth: using an orange to model different densities of the Earth's layers* and *From clay balls to the structure of the Earth - a discussion of how physics can be used to probe Earth's structure*, in conjunction with this activity, either in preparation or follow up.

## Underlying principles:

- The Earth's radius is approximately 6400km (6378km at the Equator and 6357km at the poles, on the slightly flattened sphere which is the Earth).
- The Earth's internal structure is divided into layers, - crust, mantle, outer and inner core.
- The crust is very thin. The average oceanic crust is about 8km thick. The average continental crust is about 35km thick. It reaches a maximum beneath some high mountain ranges of about 100km. The overall average crustal thickness is only 0.3% or so of the Earth's radius.
- The junction of the crust and mantle is known as the Mohorovičić Discontinuity ('Moho').
- The crust and upper mantle act as one physical unit, known as the lithosphere, but even this is no more than 250km thick – at most 4% of the total radius of the Earth.

**Thinking skill development:** Understanding the true scale of the Earth involves cognitive conflict, when pupils have the standard (often wrongly drawn) diagram in mind. Relating a toilet roll to the whole Earth may require a considerable skill in bridging!

## Resource list:

- 64 continuous sheets of a toilet roll.
- writing materials.

**Useful links:** <http://www.geolsoc.org.uk/Plate-Tectonics> and  
<http://www.nationalstemcentre.org.uk/elibrary/resource/1163/geological-changes-earth-s-structure-and-plate-tectonics>

**Source:** Based on an original idea developed at the Geological Society's Geoscience Education Academy 2013 and adapted by Pete Loader.

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