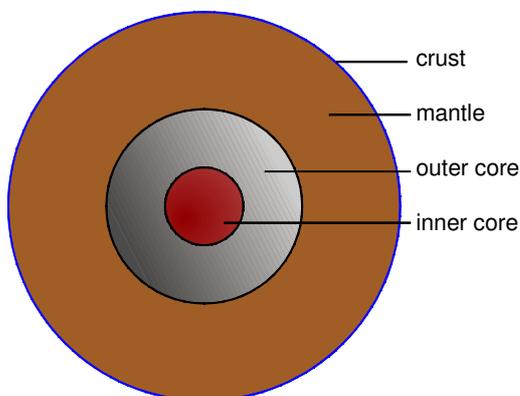


From an orange to the whole Earth Using an orange to model different densities of the Earth's layers

This activity uses an orange as a model to show the evidence for the different densities of the Earth's crust and inner layers.



Structure of the Earth

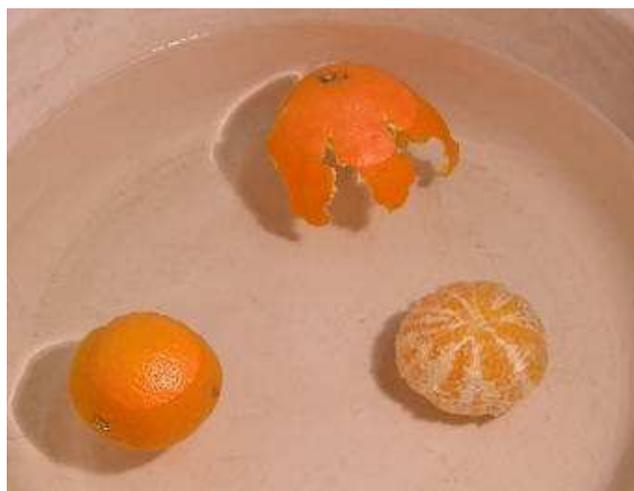
Ask the pupils

- What will happen when you put a whole orange into a container of water?
- What will happen when you peel the orange and put the orange without its peel into water?
- What will happen when you put the orange peel into the water on its own?

Then ask the pupils to carry out this investigation.

When they peel the orange, they should try to keep the peel in one piece if possible.

Tell your pupils that scientists can work out that the relative density of the whole Earth is 5.5 but the rocks of the crust of the Earth have a much lower average relative density of 3.0. This means that the layers inside the Earth must be more dense than the crust, just like the orange.



Oranges and orange peel in water
Photo: Elizabeth Devon

The back up

Title: From an orange to the whole Earth

Subtitle: Using an orange to model different densities of the Earth's layers

Topic: This activity can form part of a lesson about density and the structure of the Earth.

Age range of pupils: 10 - 16 years

Time needed to complete activity: 20 minutes

Pupil learning outcomes: Pupils can:

- realise that one object may be made of layers of different density;
- use a model to demonstrate that the Earth is made of layers of different density.

Context:

The orange is analogous to the Earth in having a relatively dense centre (mantle/core) and a much less dense skin (crust).

Answers to the questions:-

- What happens when the pupils put a whole orange into a container of water? *The whole orange floats. The mass of the orange is less than the mass of the same volume of water.*
- What happens when they put the orange peel into the water? *The orange peel floats because the peel is made of low density, non-absorbent material.*
- What happens when they put the orange without its peel into the water? *The orange without its peel sinks. This is because the mass of the orange is greater than the mass of the same volume of water.*

Following up the activity:

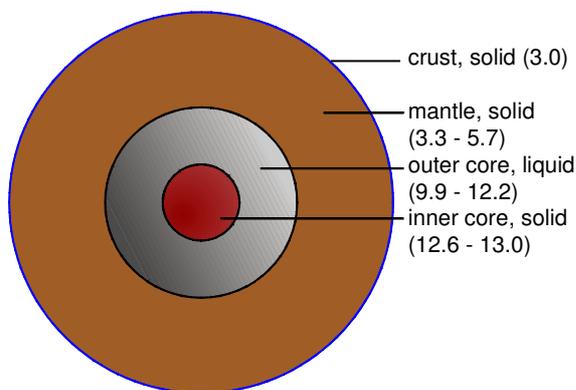
If equipment is available the pupils could find the mass, the volume and therefore the density of the whole orange, the peel on its own and the orange without its peel.

$$\text{density (gml}^{-1}\text{)} = \frac{\text{mass (g)}}{\text{volume(ml)}}$$

They could be challenged to find out how we know the size and mass of the Earth. (The size is now measured by satellites, but the Earth's circumference was first measured by Eratosthenes in around 250BC by measuring the angle of the Sun at midday on Midsummer's Day at two different points in Egypt and then measuring the distance between them. His figure was only about 1% in error! The mass of the Earth is calculated using Newton's gravitation equations.)

Underlying principles:

- the Earth is made of concentric layers of different density
- it can be concluded from the overall relative density of the Earth (5.5) that the centre must be more dense than the crust (average relative density 3.0)



Layers of the Earth, solid or liquid and relative densities

Thinking skill development:

- The orange has an outer layer around its core; the Earth also has an outer layer and a core, (pattern, construction).
- The whole orange floats while the orange without its peel does not, (cognitive conflict).
- Explanation of the reasons why the whole orange floats but the central core does not, (metacognition).
- The density of parts of the orange can be related to the density of layers of the Earth, (bridging).

Resource list:

- containers, each large enough to hold an orange floating in water,
- some oranges.

Useful links:

- <http://scign.jpl.nasa.gov/learn/plate1.htm>
- http://www.moorlandschool.co.uk/earth/earths_structure.htm

Source:

Developed from an activity devised by Abigail and David Brown.



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