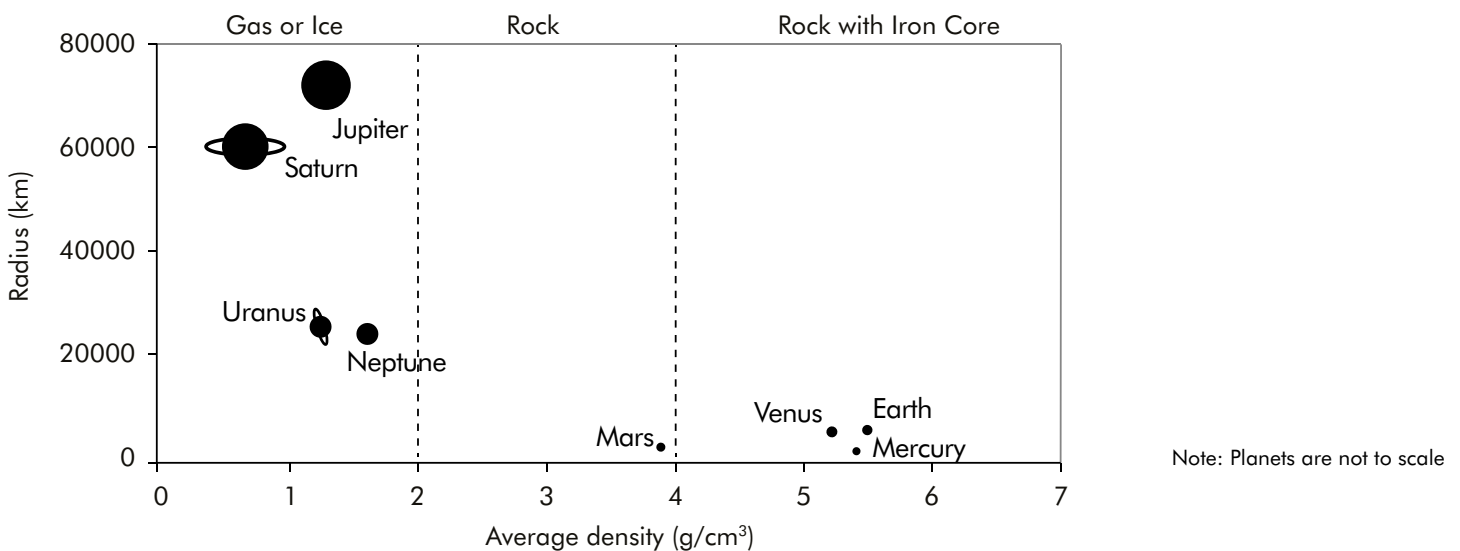


FINDING AN EARTH-LIKE EXOPLANET: PLANET DENSITY

To find out what an exoplanet is made of, astronomers look at its size and mass. From this they can calculate its density. This will help them to decide whether it is likely to be a rocky planet like the Earth or a gas giant.



The biggest planets of the Solar System (Jupiter and Saturn) have the lowest densities. They are gas giants, made of frozen gas or ice. We couldn't live there. The Earth is more dense. It is a rocky planet with an iron core.

The Earth's average density is about 5.5 g/cm^3 . That is in between the density of rock (about 2.5 g/cm^3) and the density of iron (7.9 g/cm^3).

In this activity you will find out how much of the Earth is rock and how much is iron.

What you'll need:

- Balance
- Measuring cylinder
- Steel ball bearing or steel block approx. 2 or 3 cm across
- Sand

What you need to do:

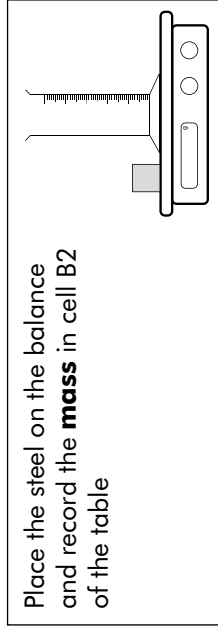
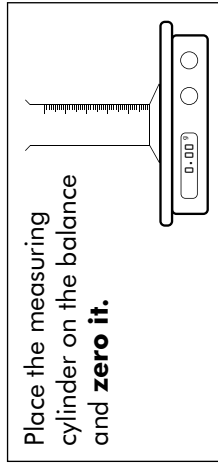
The steel represents the core of a planet. The sand represents the rocky exterior.

1. Measure or calculate the volume of the steel. (Decide on your own method for this.)
2. Zero the balance. Measure the mass of the steel.
3. Work out the density of steel using

$$\text{Density of steel} = \frac{\text{mass of steel}}{\text{volume of steel}}$$
4. Remove the steel from the balance.
5. Follow the instructions on the student worksheet to work out the density of a steel-sand mixture and the percentage of the Earth made of iron.

PLANET DENSITY: MODELLING THE EARTH

Record the volume of the steel in cell A2 of the table



Add some sand and record the total mass and volume of sand in cells B3 and C3 of the table

	A	B	C	D	E	F
	Volume of steel (cm ³)	Total mass (g) (sand + steel)	Volume of sand (cm ³)	Total volume (cm ³) (sand + steel)	Steel percentage by Volume	Average density (g/cm ³)
1			0		100 %	
2						
3						
4						
5						
6						
7						

Gradually increase the amount of sand, recording the total mass in column B and volume of sand in column C of the table

For each of your values calculate the total volume (steel + sand). Record your answers in column D

For each of your values calculate the percentage of the total volume that is steel using $Steel \% = \frac{Volume\ of\ steel}{Total\ volume} \times 100\%$
Record your answers in column E

For each of your values calculate the average density using $Average\ density = \frac{Total\ mass}{Total\ volume}$
Record your answer in column F

Plot a **graph** of average density against steel percentage. Use the graph to work out the percentage of the Earth occupied by the core

Taking it further Use the internet to find out about the densities of some exoplanets. Which are likely to be gas giants? Which might be Earth-like?