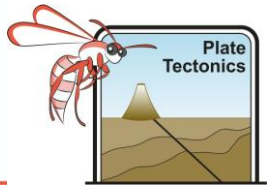
GIC - Our Hollow Earth - Teacher Notes



Primary and secondary data

Data is anything that is observable, measurable and repeatable. Primary data is data collected directly by the observer for a particular purpose. Secondary data has been collected by another observer for a similar reason and reused by a later scientist.

Background to early ideas on the structure of the Earth

In 276Bc Eratosthenese, an Ancient Greek scientist, fairly accurately estimated the circumference of Earth. He noted that at midday in mid summer the overhead sun shone directly down a deep well in the town of Alexandria, which lies on the Tropic of Cancer. He knew however that if he tried to do the same thing in his hometown of Syene further south, sunlight would be blocked by the shadow of his body. Erastosthenese realised that the surface of the Earth must be curved and that the Earth was a sphere. He calculated the elevation of the Sun using the gnomon from a sundial. As a result of measurements made during surveying trips he also knew the distance between the two towns. He concluded that if the Earth was a sphere the arc between the two wells was 1/50th of its circumference. This information was used by later scientists to calculate the volume of the Earth.

In 1687 Newton published his great "Principia Mathematica" which used mathematics and astronomical observations of his own on and of earlier scientists like Eratosthenese to explain planetary movement, size, density e and position. It was truly ground breaking science.

Edmund Halley the astronomer looked at one small section of Book 3 which estimated the relative masses of the Earth and Moon. Newton had miscalculated stating their relative masses were 1 to 26 making their relative densities 9 to 5. Newton made this estimation by observing the effect of the Sun and Moon on our tides. (Gravitational pull from the Sun and Moon affect water level). The moon's density was incorrect by a factor of three.

Halley proposed "Sir Isaac Newton has demonstrated the moon to be more solid than our Earth, as 9 to 5; why may we not suppose four ninths of our globe to be a cavity?" Haley also proposed that between the three hollow spheres was atmosphere and that the Aurora Borealis was escaping gas from within the hollow Earth. Halley had read accounts of caverns, cave systems and disappearing rivers in karst (limestone) country and many ancient stories of people living underground. He also tried to explain the wandering of the magnetic pole by proposing each shell had its own poles and would rotate at different speeds.

Robert Hooke, the Curator of Experiments for the Royal Society of London and others had already proposed that Earth was composed of spheres but did not suggest that there was space between the shells.

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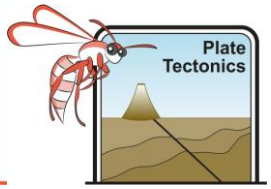

In due course the mathematical mistake was corrected and the idea of a hollow earth fell out of favour.

In the table below enter examples of primary and secondary data used by some of these scientists

Primary data

Scientist	Example of Primary data
Eratosthenes	He measured the elevation of the Sun
Eratosthenes	He measured the distance from Syene to Alexandria
Newton	He made astronomical measurements
Newton	He measured the effect of the Moon on tides on Earth
Halley	In this case he did not use primary data

Secondary data

Scientist	Example of Secondary data
Newton	He used data from earlier astronomers
Newton	He used data on the circumference of the Earth from Eratosthenes
Halley	He used data from a book
Halley	He used information from stories

Get together with another student and "Think, Pair, Share". What are the advantages and disadvantages of using primary and secondary data?
Share your findings with the rest of the class

Data type	Advantages	Disadvantages
Primary	Scientist selects samples to suit their research area Scientist can control choice of equipment to provide precision and accuracy Scientists can be confident of their own data	Takes time Expensive Personal prejudice might affect sourcing
Secondary	Cheaper Faster Less likelihood of personal prejudice affecting sample choice Wider sample choices may uncover new factors which could influence research	May not quite suit the research project Little control over accuracy or precision

From data we may make inferences. Inferences are themselves not facts. They try to logically explain why something may have happened.
Our grandparents thought we "caught a cold" by sitting in a cold place. We now understand that colds are the result of bacterial infection. Poor nutrition during winter caused a reduction of efficiency in our immune systems. Opportunistic germs could more easily attack.

As more data is collected (we can catch the cold at any season) and as improved technology is employed (microscopes show us bacteria and electron microscopes show us viruses), inferences may change.

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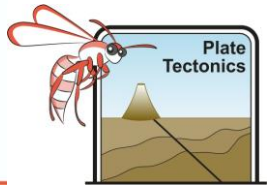

An example of using primary and secondary data for economic advantage

Having people trained to understand earth processes is very important for Western Australia, a state dependant on resource industries for a lot of its income.

In Western Australia rock has been weathered and eroded for millions of years and mineral deposits lie obscured by tens or hundreds of meters of overburden.
Government and industry geologists created geological maps that extend known outcrops to connect with others of the same kind using structural and mineralogical evidence collected in the field.
Mineral exploration geologists then select areas where deposits might be found by studying these geological maps and comparing them with maps from areas of known mineralization elsewhere.
Geophysical surveys are then flown over prospects. Geophysical techniques can penetrate deep into the ground. Gravity and seismic surveys may indicate denser areas of differing rocks and structures, magnetic surveys may indicate metal deposits and radiometric surveys indicate the presence of radioactive minerals.
Interpretation of magnetic surveys result in finding large mineral deposits such as Telfer gold deposit and interpretation of the results for seismic surveys are essential in discovering and developing oil and gas fields.

Use this information to complete the table below

Primary data	Secondary data	Inference
Known geological outcrops	Areas mapped by other people	The area is/is not worthy of further exploration
Data from magnetic surveys	Surveys done elsewhere	The area is/is not prospective for magnetic minerals
Gravity surveys	Established geological data	Useful structures may be present
Seismic data	Other geophysical surveys	Mineralised rocks may/may not be present Structure to trap oil and gas may be present
Radiometric surveys		Radioactive minerals may/may not be present

Of course our views are coloured by those of previous generations. Later generations may have more data from advanced technology and these ideas will change. Shales, which were passed over during early oil and gas exploration phases, are now being explored for new oil and gas deposits.