

Teachers' Notes for Journey to the Centre of the Earth

About the Author: Jules Gabriel Verne

Jules Gabriel Verne (1828 -1905) was a French author and a pioneer in the science fiction genre. Verne was noted for writing about cosmic, atmospheric and underwater travel before air travel and submarines were commonplace and before practical means of space travel had been devised. He is the third most translated author in the world.

About the Performer & Playwright: Mark Penzak

Working under the company name of BlueBoat, I've been creating theatre for children for over 30 years and estimate that I've performed to over half a million children. My theatrical style features innovative sets and puppets combined with storytelling and characterisation. I like to take the audience on a theatrical voyage – to be transported into imaginative worlds. Sometimes the voyage is pure comedy or action/adventure but at other times the exploration is more thematic. Either way, I like my theatre to be fun, exciting and magical. My productions have toured festivals and schools around Australia and overseas.

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The Science - What's in the centre of the Earth?

I often get asked this question so here's some interesting information:

Hollow Earth Hypothesis

The idea that the world is hollow was once considered a serious scientific theory. In 1692 the famous English astronomer and mathematician, Sir Edmond Halley (1656-1742), presented to the Royal Society an idea that the earth consisted of an outer crust, 500 miles thick, and a hollow interior containing three smaller spheres, one within the other, approximately the size of Venus, Mars, and Mercury. Halley speculated that the inner spheres might be inhabited. Leonhard Euler (1707-1783), the noted Swiss mathematician and physicist, proposed in 1767 that the earth's hollow interior contained at its centre a small glowing core which served as a miniature sun for the inner world's hypothetical inhabitants. Sir John Leslie (1766-1832), a Scottish physicist and mathematician, proposed that the earth had a hollow interior containing two suns, Pluto and Proserpina. It is thought that Jules Verne's *Journey to the Centre of the Earth* was partly inspired by Leslie's ideas.

Human exploration of the Earth's mantle

Given that the distance from the surface to the middle of the Earth is 6,370 kilometres, measured in terms of physical exploration, we've only scratched the surface.

The deepest known cave is Krubera Cave or Voronya Cave. It is located in the Arabika Massif of the Gagra Range of the Western Caucasus, in the Gagra district of Abkhazia, a breakaway region of Georgia. The difference in elevation of the cave's entrance and its deepest explored point is $2,197 \pm 20$ metres.

The deepest mine is Mponeng a gold mine in South Africa's Gauteng province. It extends over 4 kilometres (2.5 mi) below the surface. The trip from the surface to the bottom of the mine takes over an hour. The temperature of the rock reaches $66\text{ }^{\circ}\text{C}$ ($151\text{ }^{\circ}\text{F}$), and the mine pumps slurry ice underground to cool the tunnel.

The deepest penetration of the Earth's solid surface is The Kola Superdeep Borehole on the Kola peninsula of Russia which reached 12,262 metres (40,230 ft) and has shown the earth's crust is mostly porous.

How do we know what's inside the Earth's interior?

'We know amazingly little about what happens beneath our feet. It is fairly remarkable to think that Ford has been building cars and Noble committees awarding prizes for longer than we have known that the Earth has a core. And of course the idea that the continents move about on the surface like lily pads has been common wisdom for much less than a generation. 'Strange as it may seem,' wrote Richard Feynman, 'we understand the distribution of matter in the interior of the sun far better than we understand the interior of the earth.' Bill Bryson A Short History of Nearly Everything 2003

Our understanding of what is happening under our feet is based on studies in several inter-related disciplines including:

Geology: The science that deals with the history of the earth as recorded in rocks. In particular we get some idea of underground composition by looking at Kimberlite pipes. These are huge upward explosions of magma that originate as far as 200 kilometres below and so contain mineral samples from that region. (It is in these solidified pipes that diamonds are sometimes formed during the cooling process.)

Geophysics: Which is Geology that uses physical principles to study properties of the earth viewed globally.

Volcanology: The study of volcanos.

Seismology: Is the study of earthquakes and seismic waves that move through and around the earth.

It is largely through the interpretation of seismic waves as they are reflected from inside the planet that leads scientists to generally agree that the planet is composed of four layers - a rocky outer crust, a mantle of hot viscous rock, a liquid outer core and a solid inner core. It is estimated that the temperature of the inner core is 4000 degrees to over 7000 degrees Celsius - about as hot as the surface of the sun and that the pressure at the core is 3 million times the surface pressure.

We know the surface is dominated by silicates, which are relatively light and not heavy enough to account for the planet's overall density. Therefore there must be heavier stuff inside. We know that to generate our magnetic field somewhere in the interior there must be a concentrated belt of metallic elements in a liquid state. That much is universally accepted - how the layers interact, what causes them to behave in the way they do, what they will do at any time in the future remains a matter of uncertainty.

Two Interesting Internet Sites Showing the Science.

Excellent BBC animation of a Journey to the Centre of the Earth showing a realistic portrayal of what you would experience.

<http://www.bbc.com/future/bespoke/story/20150306-journey-to-the-centre-of-earth/>

A map that shows where you'd end up on the other side of the world if dug straight down into the ground.

<http://www.livephysics.com/simulations/mechanics-sim/dig-hole-earth/>

Writing or Cartoon Exercise:

Jules Verne is considered one of the first writers of the science-fiction genre. So what is Science-fiction? Author Theodore Sturgeon wrote that "a good science-fiction story is a story about human beings, with a human problem, and a human solution, that would not have happened at all without its science content."

The following could be done either as a writing exercise in 5 paragraphs or as a cartoon based on 5 panels.

1/ First Panel or Paragraph. The story starts in a science lab or a place of exploration. For example, it could start with scientists trying to create a time machine or journeying on a spaceship to Mars.

Decide what are the scientists trying to achieve or discover?
Do they have any special equipment such as a super computer?

2/ In the second paragraph or panel, make something go seriously wrong. Maybe the scientists create a dangerous new animal? Maybe equipment malfunctions and puts everyone in danger? (For example, the spaceship's rockets malfunction and head straight towards the sun.)

3/ In the third paragraph/panel show that the situation is becoming critical. For example, a monster goes on a rampage or the spaceship is about to burn.

4/ In the fourth paragraph, show the scientist discovering a way to fix the situation. Maybe they defeat the monster or stop the spaceship? Could they fix the equipment or use something else to do the job? Maybe they could find a way to make friends with the monster rather than fighting?

5/ In the final paragraph/drawing we see that the danger is over. Maybe everything returns to being as it was before but if possible, show that things are somehow different. Maybe the once dangerous monster is now going to school? Maybe the scientists have learnt from their mistakes and are about to launch a new and improved rocket?

Discussion Topics

1/ Caves, tunnels and underground passages seem to resonate in our imagination. Milton's *Paradise Lost*, the myth of Orpheus and Eurydice and Dante's *Divine Comedy* all feature underground worlds. Some examples children might know are Alice in Wonderland - where Alice enters through a rabbit hole, Aladdin's Cave and Batman's Cave.

2/ Can the students think of other examples of famous caves, dungeons or tunnels? Harry Potter has several examples.

3/ Ask the students why they think underground places are exciting? Is it because they are dark and hidden from our sight?

4/ What kind of real animals live in caves and how are they different from us?

5/ What kind of imaginary or mythological creatures could live in caves?

6/ What objects can you really find in caves? Limestone stalactites (growing down from the ceiling) & Stalagmites growing up from the floor. Rubies?. Diamonds?

7/ What other imaginary things can you think of – sunken treasure? The city of Atlantis?

Idea for Illustration

Let the children draw a picture of a cave filled with either real or imaginary objects, monsters or animals. The pictures are then hung on the wall and then linked by a series of drawn tunnels so that they form a giant maze. These pictures can be used for a maths game where the students have to work out the number of caves they would need to pass through to move from one particular cave to another.

Drama Exercises

Going on a Journey

To begin, ask the students to list possible states they could find on an imaginative Journey to the Centre of the Earth. For example, hot, cold, icy, windy, sticky. Also emotional states – scary, dangerous, exciting, awesome.

Divide the class into groups of 4 or 5.

Starting with everyone standing in their groups on one side of the room, a student or the teacher, calls out one of the states. Then one member from each group (so that 4 or 5 people start at the same time), moves across the space as if experiencing the state. For example, if the state was sticky, the kids step as if their feet were sticking to the floor. If it was icy then the participants would slide. After the first person has taken a few steps, the next wave of participants starts.

Human chain across the space.

Staying in groups, one member from each group, steps into the space and freezes with their arm, or other body extremity such as a leg, outstretched towards the far wall. The next person in the group links to the first person. This could be simply holding hands but try to be imaginative. A person could extend their leg or lean against the first person. After that link occurs, a third person from the group joins in, followed by the 4th and so on forming a human chain across the space. When all members of the group are joined together, the first person breaks from the rear and joins the front so that one by one, the human chain moves across the space.

Writing and drawing exercise for younger students

First explain to the students what is meant by the words, 'characters, setting and props' using examples from the play.

Next using the following template, ask the kids to draw their favourite character, setting and prop.

Then ask them to write answers to the questions, 'My favourite part of the performance was?' and 'If you went on a fantastic journey where would you go?'

JOURNEY TO THE CENTRE OF THE EARTH

THE CHARACTERS

THE SETTING

INTERESTING PROPS

MY FAVOURITE PART OF THE PERFORMANCE WAS:

IF YOU WENT ON A FANTASTIC JOURNEY WHERE WOULD YOU GO ?