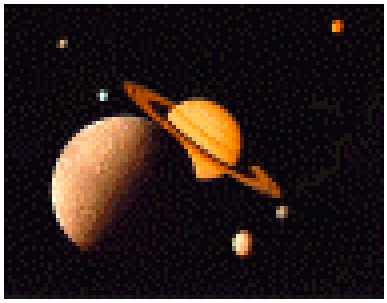
Let's go 'Out There'

Whenever we are planning to go somewhere new we want to find out about the place. If it is somewhere we might visit on business or on holiday we probably want to know what the food is like, is it hot or cold, is it safe to walk around, what the night clubs are like, are the beaches sandy or rocky – lots of information that help us to take the right clothes and behave sensibly whilst there. This information is readily available from books, travel agents, magazines and the internet or maybe from friends or family who have already been there.

But if the new place is far out in space, way out in the Solar System, then the questions are a little more basic and the answers are a lot harder to find!

Where are we going? To Saturn and Titan



Saturn and its moons. Titan is at the top right.

In 1997, a joint ESA/NASA mission, Cassini-Huygens, was launched to study the planet Saturn and its large moon Titan. After travelling 3.2 billion kilometres, it should reach Saturn by July 2004. It hasn't gone directly to Saturn but has used gravity, gained from flying by Earth and Venus, to increase its speed. It is now speeding along at a very, very fast 32 km/s.

Just think about that – nearly as far as a marathon run in just one second!

The Cassini-Huygens spacecraft is named after two seventeenth century scientists.
Jean Dominique Cassini, an Italian who discovered that Saturn's flat rings are in fact two rings separated by a dark band, which became known as the Cassini Division. We now know that Saturn has eight major rings, each with hundreds of subdivisions. Christiaan Huygens, a Dutch astronomer and telescope maker, discovered Titan in 1655, at a time when improved telescopes and a great interest in science generally brought about many exciting discoveries.

Why Titan?

Because the conditions on Titan may be similar to the conditions that existed on Earth before life began. Finding out about Titan may help us to understand the beginning of life on Earth. Titan has a thick atmosphere of orange clouds composed mostly of nitrogen but also containing some carbon compounds including methane, which is the natural gas found on Earth. It is the intriguing possibility of finding out about the early atmosphere of the Earth, which might tell us where our own nitrogen and water came from, that made scientists so keen to send Cassini there.

What does Cassini-Huygens look like?

The spacecraft consists of an orbiter, **Cassini**, which will orbit Saturn for at least four years going round Saturn as many as 48 times, and a probe, **Huygens** which will descend to the surface of Titan.

Artist drawing of Cassini-Huygens. (Image from ESA)

So how will we find out about Titan?

British scientists designed and developed eight of the eighteen instruments onboard Cassini-Huygens. The Huygens probe has six instruments on board which will analyse the chemical composition of Titan's atmosphere, provide information about its weather and also find out what the surface is like. Rutherford Appleton Laboratory was involved with three of these including development of sensors and engineering support on the Surface Science Package (SSP). The SSP will perform direct measurements on the previously unseen surface of Titan. We don't know whether Huygens will hit solid ground or splash into a sea of liquid methane. The package of instruments will send back data that will tell us how hard and flat the landing site is. But first, you have to slow the lander down so it doesn't smash into Titan and break all the sensitive measuring instruments.

The Titan probe lander

The Huygens probe will be released from Cassini in November 2004. It will spend three weeks travelling to Titan at 6 km/s. The final descent to the surface will be slowed by a series of two parachutes so that the final impact will be relatively gentle.

Your mission

Artist impression of the Cassini landing. (Image from ESA)

Design and build a device that will safely land a probe (or in this case a fresh egg) onto the surface of Titan. In the event of several landers able to do this, the winner will be the one that takes the longest time for the descent. Remember the 'probe' must be able to touch the surface so leave at least some of the egg able to contact the ground directly.

Rules: Work as teams of 3-4. You have 20 minutes to complete your mission.

What can you use?

Your teacher will show you the materials you can use. These will probably include:

Sheet of newspaper
Black plastic bin liner
1m to 2m of thin string
Cardboard (more or less any size or shape will do)
Sheet of brown paper
Sticky tape
Scissors

Titan – hard or soft?

Assuming you have perfected your parachute so your probe lands nice and gently, what will you find out about the surface of Titan?

You can try out a hardness probe which is similar to the actual design of the surface hardness probe sent to Titan.

When the probe hits a surface a small voltage is generated which is measured and displayed. The graphs show the voltage on the y-axis and time on the x-axis. By comparing the traces from unknown surfaces with those from known ones it will be possible to find out whether Titan is hard or soft. Other instruments will find out the temperature and composition and then all the information will be used to answer the question what is it like on Titan?

What can we learn from the probe?

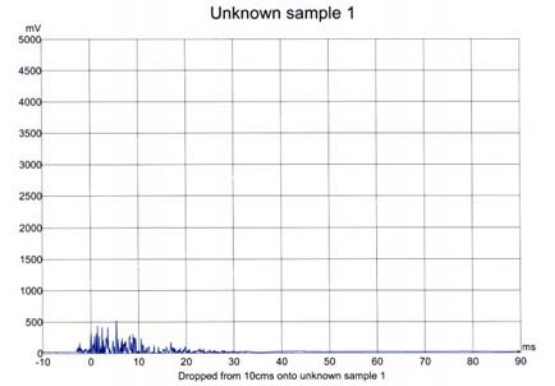
You will be given some graphs made using a probe lander very similar to your own. Compare the unknowns with the known ones. Write down what you conclude about the unknown surfaces. They may not match exactly so think about what surface might have given the graph.

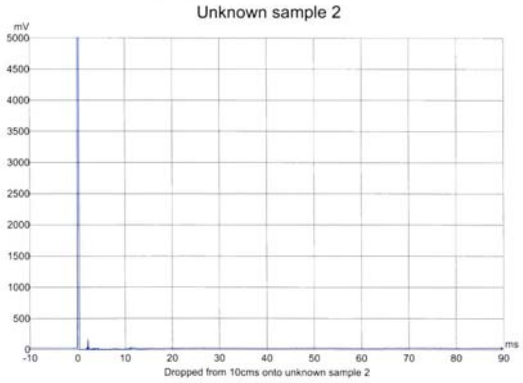
You may be able to do this experiment as a practical activity in school.

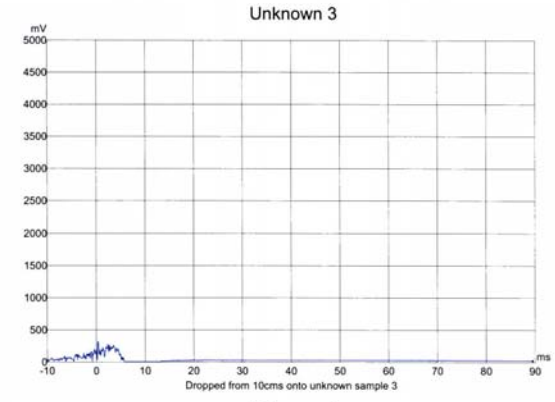
What will you need?

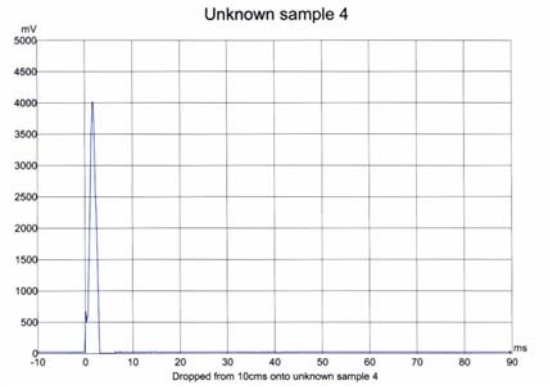
- A hardness probe (penetrometer) to measure the impact when your lander hits the surface.
- A computer that can record your data.

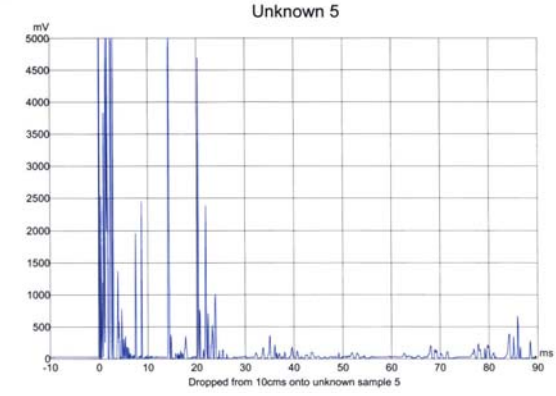
Unknown sample surfaces

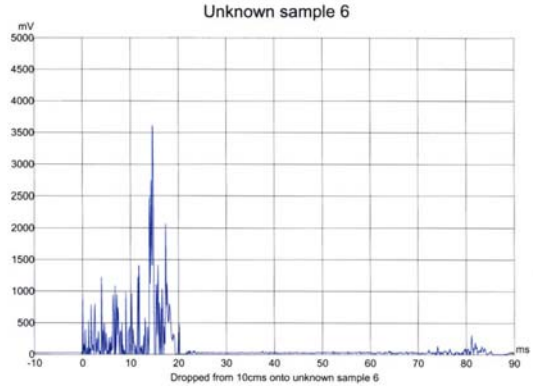


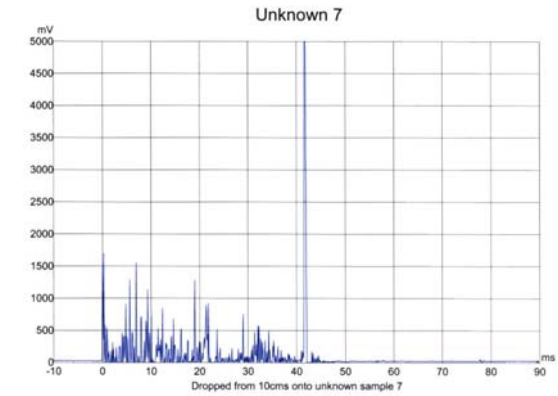


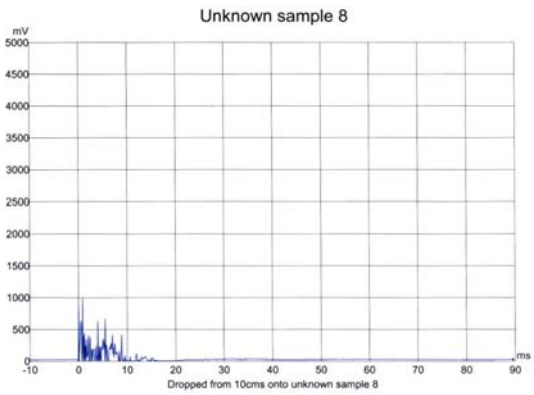












Known sample surfaces