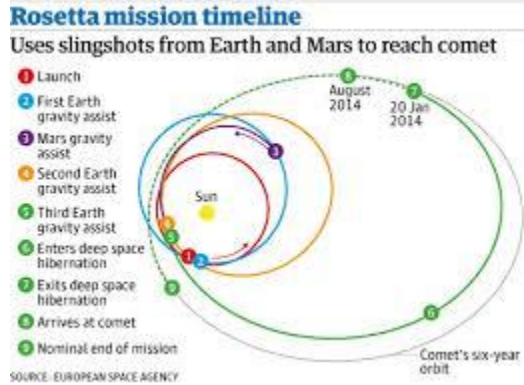


Worksheet: Landing on a comet! The Rosetta project



ACTIVITIES:

Please read the following text:

“Further analysis indicated that the lander had bounced twice and landed three times; the first bounce (with a velocity of 0.38 m/s, compared to 1 m/s incoming) lasted two hours and may have been 1 km (0.62 mi) high, the second (at 0.03 m/s) lasted seven minutes. The initial bounce was the largest in history at 1 km (0.62 mi), because of the very low gravity on the comet. Philae sits askew, leaning on a rock in partial darkness as much as a kilometre from the first landing spot at an unknown location. At first it was thought that it sat on just two legs; ESA later determined that the lander sits on all three legs”.

1. What is the motion of Philae during time? You can divide the motion into steps:

2. From the text above please find the data:

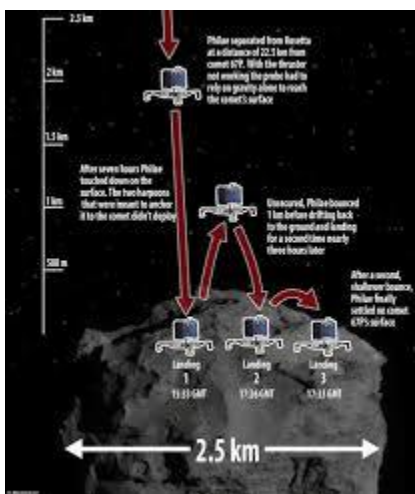
3. Write the equations of motion for each step of motion:

4. Is it possible to find the acceleration of gravity of the comet? (g)

5. Open the Interactive Physics Software. How can you simulate the free fall of an object?

6. What are the changes that we have to make in order to simulate the free fall of Philae on the comet 67P?

7. Is it possible to find the acceleration of gravity for the specific comet? (using IP software)



THE ROSETTA MISSION HOW IT GOT THIS FAR AND WHAT HAPPENS NOW

THE JOURNEY TO THE COMET

- 2 March 2004** Rosetta launched
- June 2011** To save energy, Rosetta is put into hibernation after four flybys of Earth and Mars
- January 2014** Rosetta wakes up from deep-space hibernation
- 6 August** Mapping comet 67P/C-G to find suitable site for lander
- TODAY** Lander will be deployed on comet
- August 2015** Closest approach to the Sun
- December 2015** Mission ends

CHOOSING A PLACE TO LAND

The Rosetta spacecraft carries a lander called Philae and has been scanning the surface of the comet 67P/C-G since August looking for a suitable place for Philae to land

Mission controllers finally selected a landing site located near the head of the comet which is an area with fewer slopes steeper than 30-degrees, the maximum that the lander can cope with

LANDING ON THE COMET

Today at 09.03 GMT
Once Rosetta is aligned correctly with the comet, the Philae lander will be pushed away from the main spacecraft at a velocity of 18cm per second

TOUCHDOWN
15.30 GMT
The lander could touch down anywhere within half a kilometre of the chosen landing site and will need to avoid boulders which could upturn or wreck Philae. The legs of the lander will absorb most of the impact and immediately after touchdown, a harpoon will fire to anchor the lander to the ground

A VAST ROCK

This map illustrates the comet's vast size compared with London.

34,000
The speed in miles per hour that the comet is travelling

28
Number of minutes it takes for a signal to travel 500 million km from the comet to Earth

WHAT THE LANDER WILL DO

Instruments on board the lander will be used to carry out nine experiments and they include a drilling system which will take samples of subsurface material. The battery aboard Philae will last between 40 and 50 hours after which it will switch to rechargeable batteries powered by solar panels

- Solar panels**
- Harpoon** Attaches probe to comet and measures density and thermal properties
- X-ray and radiowaves** To examine internal structure
- Sampling system** Can drill 20cm into the surface. Samples deposited for microscope inspection
- Legs** Designed to dampen the initial impact to avoid bouncing

The seven-hour descent
Cameras will take pictures of the receding mother ship and oncoming comet

The magnetic field of the comet will be probed, and dust and plasma measurements taken

Radar will measure the rate of descent and examine the comet's surface and interior