

Hi this is Steve Nerlich from Cheap Astronomy www.cheapastro.com and this is *The Mars Science Laboratory*

It's like life really. First you have Spirit, then you have Opportunity and then comes Curiosity. But long before Curiosity's had a chance to take off, Spirit gets bogged down and the next stop for Opportunity seems miles away – and you start dreaming of the good old days when there was just a Sojourner.

The latest Mars rover, still under construction and originally referred to as the Mars Science Laboratory, but now called Curiosity – is scheduled for launch in September 2011. Its exact landing site remains the subject of discussion and will be informed by data still being collected, including data from Spirit and Opportunity – even if Spirit's contribution from hereon is just to take detailed observations of the bog it's stuck in.

The ideal landing site will be one within 45 degrees of the equator and less than one kilometre above the Mars datum – the equivalent of sea level on Earth – but we say datum because of course there is no sea – and it's easier to say datum than the fourth-degree surface of equal gravitational potential. If you are curious, remembering that 1 atmosphere is Earth's atmospheric pressure at sea level, the atmospheric pressure at Mars datum is six millibars or 0.006 atmospheres.

Also there's an intention to land Curiosity in an area with evidence of liquid water having been there in the past – ideally with lots of hydrated and clay minerals like hematites and silicates which can be found by spectroscopy. Apparently, such minerals are excellent substrates for fossil preservation, at least they are on Earth.

Curiosity's launch is currently scheduled for the 15th of September 2011 and will use the two stage heavy-lifting Atlas V rocket which has launched other recent interplanetary missions, notably the Mars Reconnaissance Orbiter launched in August 2005 and New Horizons which was launched in January 2006 – and is still in transit towards a fly-by of Pluto on the 14th of July 2015.

So, there's reason to think Curiosity's launch will be fairly routine, but as with the current rovers, one of the most technically challenging parts of the Curiosity mission will be the landing. Mars' thin atmosphere is enough to create some aerobraking, but not enough aerobraking to really slow it down that much. So, having partly descended within a protective aeroshell, the landing craft will deploy a huge 16 metre diameter parachute to gain as much benefit as possible from the tenuous atmosphere. Then the rover, suspended beneath a decent stage, will drop out of the aeroshell and the descent stage will fire hydrazine rockets for further slowing until it achieves something close to a hover above the surface.

From there, the rover will be lowered by a sky crane system – which it will then cut itself loose from with little explosive charges when it contacts the ground, leaving the descent stage to crash land at a distance. This sky crane system has never been used before – but the air bags used to land Sojourner, Spirit and Opportunity just aren't going to work for the much heavier Curiosity.

In addition to cameras and spectrosopes, which Spirit and Opportunity had, Curiosity will be able to analyse soil samples it scoops up – and any powder it collects by drilling into rocks. It has little internal ovens for chemical separation and hopefully identification of organic molecules.

And something that might get the kids wanting a radio-controlled Curiosity for Xmas is the proposed Laser Induced Breakdown Spectroscopy instrument. LIBS, for short, can apparently (it's in Wikipedia) target a rock or soil sample up to seven metres away – and vaporise it with a laser blast so that the vapour can then be analysed spectroscopically. Actually, I wouldn't mind one for Xmas.

Apart from that, more serious spectroscopy gizmos will measure oxygen and carbon isotope ratios in the carbon dioxide and methane of Mars atmosphere with the expectation of determining whether they have a biological or geothermal origin – which has been the subject of a long and ongoing debate so far.

And there's also RAD – a radiation assessment detector which will map the radiation spectrum on the surface of Mars to determine the 'shielding needs' of future human explorers. Cheap Astronomy's tip – you're going to need that light weight but lead material that no-one's invented yet. But hey, whoever invents the light weight shielding for the spacecraft that has to deliver those humans over the nine month voyage to Mars – I'm sure they can be come up with some appropriately shielded space suits in a trifle.

See, all we have to do is keep investing in research and education and not constantly demand more tax cuts – a minutiae of which actually goes into education and research. Because either you give up that tiny little morsel of your hard earned income or...

Ah, Steve I think this is where you wanted me to come in and stop you if you started ranting.
Oh, right – thanks.

At 2.7 metres in length, Curiosity is nearly twice as long and at 900 kilograms has more than four times the mass of either Spirit or Opportunity. Curiosity is also planned to be substantially faster. Whereas the two current rovers were able to move at an average speed of 6 metres an hour, Curiosity is able to move at 30 metres an hour.

And Curiosity's mission is scheduled to last for 2 years, but well, you know how these things go... the existing rovers were only scheduled to last for 3 months – and have been going over six years now, so having Curiosity going for 10 or more years is certainly not out of the question. That is, assuming its various system could hold up that long.

The ultimate limitation is probably its power source – which is a radioisotopic thermoelectric generator, while Spirit and Opportunity are primarily reliant on their solar panels – of which Curiosity has none. Running off an RTG means Curiosity could work both day and night – and its RTG is expected to deliver useful power for at least 14 years. And that's 14 years of 24/7 science. It won't have to shut down for winter either.

But now we find ourselves in a climate of budget cuts and restraint – so it's probably fair to ask whether all this is actually going to happen. I mean come on – a robot that weighs nearly

a metric ton and fires laser beams – with a developmental budget already exceeding two billion dollars. And we are just going to land this thing on another planet, via an unprecedented landing system, in 2012. I mean...really?

But hey, we've already landed three rovers successfully – and, you know, with air bags. So, we are already capable of some pretty sophisticated engineering feats and once you're operating at that sort of level, landing a nearly one tonne rover on another planet using a sky crane does start sounding kind of plausible.

And look Spirit and Opportunity are OK... but a giant rover that can fire laser beams? This is where the future of humanity should be heading. Let's just do it people.

Thanks for listening. This is Steve Nerlich from Cheap Astronomy, www.cheapastro.com. Cheap Astronomy offers an educational website, hoping they'll eventually name a rover Frugality. No ads, no profit, just good science. Bye.