

WHY FUND SPACE EXPLORATION?

When you arrive somewhere new, what is the first thing you do?

After unpacking the suitcases most of us would probably want to EXPLORE our new surroundings - to find out about our neighbours, to find the way to the shops and clubs. If we are on holiday we will want to find the way to the beach or to find out what opportunities there will be for our stay. In fact you may have had a holiday in some far away place just to find out more about it. You are an EXPLORER!

You will have read about men such as David Livingstone, Captain Cook, Ferdinand Magellan and many others who, between them, have EXPLORED the four corners of the Earth. It is in our human nature to want to find out about our surroundings, to EXPLORE our neighbourhood, our planet Earth and beyond.

Until the middle of the 20th Century our EXPLORATION OF SPACE could only be done in our imagination. Our forebears could only look up at the sky. By watching and following the motions of our celestial neighbours would try to figure out our place in the Universe. With ever more powerful ground-based telescopes they were able to begin to study what stars were made of, to discover that galaxies other than our own Milky Way exist and that the Universe is expanding. Was this enough to satisfy our human curiosity?

A giant leap forward was made in the 1950s. On October 4 1957 the Soviet Union successfully launched the first artificial satellite Sputnik I. This tiny satellite with a diameter of only 58cm and weight 83.6 kg, orbited the Earth at a height of 900 km in only 98 minutes. As it passed overhead it was clearly visible by light reflected from the Sun, and many people all over the world set their clocks to make sure they caught a glimpse of it.

Nowadays there are so many satellites in orbit around the Earth that you would only have to wait a few minutes to see one passing overhead on a clear dark night. As you can imagine there is a website with satellite predictions.

WHAT DO SATELLITES DO?

There are basically four types of scientific programmes carried out by satellites.

1. Satellites which look down on the Earth.
2. Astronomical satellites carrying telescopes to view the universe from above the Earth's atmosphere.
3. Satellites to EXPLORE the solar system.
4. Satellites such as the International Space Station carrying men and women in orbit around the Earth for long periods.

Each of these broad areas includes many different experiments. Some satellites, such as those used for transmitting communications, have already brought direct benefit to our everyday lives.

HOW MUCH DO THEY COST?

So how much does a space mission cost? Consider the cost of the space telescopes that give us such beautiful views of our Universe. Currently in orbit are the European XMM-Newton X-ray telescope costing £600 million, the NASA equivalent, Chandra, costing £2 billion, and the Hubble space telescope costing £6 billion.

How about exploring the planets? A robotic mission to Mars costs at least £250 million, the Galileo mission to explore Jupiter and its moons cost £1.5 billion, and the Cassini-Huygens mission to arrive in Saturn in 2004 has cost £3 billion.

Manned missions are even more expensive. Each US space Shuttle flight costs about £400 million, and the International Space Station will cost a staggering £100 billion when it is completed in 2004, after 6 years of construction!

WOW! THAT'S A LOT OF MONEY.

Yes, space exploration is very expensive. But let us look at the costs in another way.

Most of the space programmes are too costly for a single nation such as the UK to carry out on their own. In Europe a consortium of nations have joined together to form the European Space Agency; ESA now has 15 Member States. The government of each nation agrees to pay a certain sum each year for the running of the ESA programme and this money comes from their tax payers. In 1999 the average European citizen spent 7.30 Euros (about £4.50) on space. This is the average cost of a cinema ticket. In the UK the British National Space Centre, BNSC, co-ordinates the work of UK scientists and engineers and acts as a link with ESA.

WHERE DOES ALL THAT MONEY GO?

Much of the cost goes on paying the salaries of the 40,000 people who are directly employed in the space industry by ESA across Europe. There are another 250,000 people involved indirectly with contracts from ESA for part of a project. These ESA employees are scientists and engineers who develop the new technologies for the space experiments, they build the rockets and satellites and they analyse the scientific results which are obtained.

Every single tiny part of a space mission must work as it is intended. It has to be fail-safe, requiring testing upon testing upon testing. If something goes wrong in space there is virtually no possibility of a repair. It must work first time with a one-way ticket. If you had been responsible for part of an experiment, imagine how you would feel if that part failed and you had ruined the whole experiment. Your colleagues would be rightly angry!

This is even more important for manned space missions, where people's lives are at risk.

The benefit of so many scientists and engineers working together is immeasurable.

In the US, the space programme is run by NASA, the National Aeronautics and Space Administration.

ARE THERE ANY BENEFITS OF SPACE RESEARCH?

Teflon coatings on saucepans? No! Although this is the 'popular' example often given when someone asks what are the benefits of space research this is not true. Teflon was discovered by Roy Plunkett and introduced in 1949.

However there are plenty more real examples which have been the direct results of space research. For example, improved weather forecasting, hurricane warnings, mobile phones, search and rescue technology, improved understanding of the effect of the Sun on the Earth, robotics (e.g. the Mars Rover), miniaturisation of electronics, digital watches, freeze-dried food, solar cells, developments in computing and digital cameras in television. These are just some of the areas of our lives which have directly benefited from space research, in addition to the primary purpose of scientific exploration.

A British built high-resolution digital X-ray camera on-board the NASA satellite, designed to observe sources of X-rays in space, has proved so sensitive that similar cameras are now being used in medical research. Within 10 years old X-ray photographic film maybe a thing of the past, and all medical X-rays will appear immediately on a computer screen.

Earth observation satellites are helping farmers to know when to plant their crops and are helping yachtsmen at sea.

IN SUMMARY

We have seen how scientific research consistently leaves a trail of useful technology in its wake. Space exploration is arguably the most productive of all the sciences; not only in terms of technology, but also as a constant reminder of how fragile our lonely planet is, providing a mirror in which to view our own impact on planet Earth. Space exploration catches everyone's imagination, regardless of age, race or religion, uniting us all with a sense of wonder. It educates us, and it excites us, leaving us all with a keen awareness of our place within the Universe. And we must explore space in order to prove to ourselves that we can explore space.

But mankind has still only dipped its toes into space. Satellites now orbit the Earth and have visited the outer reaches of the solar system, but this is a very small step indeed when it comes to exploring the enormity of space.

SO, WHAT DO YOU THINK?

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Follow-up points for discussion and investigation.

1. Space Exploration is very expensive. Can any nation justify spending the millions of pounds (or dollars)? If the money was not spent on space exploration do you think there would be more money available for, say education, the NHS or even improving the railways?

2. Find out which are the 15 member states of ESA and the way that ESA operates.

The first 10 members were: France, Germany, Italy, Spain, UK, Belgium, Denmark, Netherlands, Sweden, Switzerland. These 5 countries joined later: Ireland, Austria, Norway, Finland, Portugal. Canada has also signed an agreement to co-operate on some projects.

http://www.esa.int/export/esaCP/GGG4SXG3AEC_index_0.html

3. Find out more about the experiments that are carried out in the 4 broad categories listed. For example:

- Satellites which look down at the Earth. Twenty-four hour surveillance of the Earth for scientific or military purposes. These may be used for weather prediction, detecting fires in unpopulated areas, measuring soil quality, communications, monitoring volcanic activity, monitoring long-term effects such as the effects of global warming, and the even longer term movement of continents. This group of satellites may also be used to improve communications between parts of the Earth. GPS receivers enable anyone eg walkers, sailors or rally drivers to know within a few metres where they are on the Earth's surface.
- Astronomical satellites. The Earth's atmosphere blocks out much of the radiation coming from space and so telescopes are placed in orbit at varying heights above the Earth. There are satellites sensitive to most regions of the electromagnetic spectrum. Even in the visible part of the spectrum our view of the universe is made sharper by being above the Earth's distorting atmosphere.
- Satellites to EXPLORE the Solar System. These include the Voyager missions to explore the outer solar system, Cassini-Huygens to visit Saturn, Galileo exploring Jupiter, the numerous Mars probes and others. It also includes the Apollo programme which are the only missions where people have stepped onto another body in the Solar System.

In the years between 1969 and 1972 twelve astronauts, the first of whom was Neil Armstrong, stepped out onto the Moon's surface.

See the websites <http://sci.esa.int/home/ourmissions/index.cfm> and <http://spacescience.nasa.gov/missions/index.htm>

4. Satellite predictions are available on the following website, <http://www.heavens-above.com/>. Have a look for some bright satellites.
5. Should spacecraft be built to be fail safe or should the Space Agencies take more risks, on the basis that if it fails they can send up another one. The US has tried this strategy with its 'smaller, faster, cheaper' programme but it has led to some expensive failures. Does this matter?
6. The UK doesn't have a manned space programme. One reason for this is the cost. The UK says that robots can be equally effective. Would the public take more interest in space missions if it involved more astronauts?
7. Should we send astronauts to Mars and beyond? What are the problems with long-term space travel? What would the astronauts have to take with them? Compare this with world explorers such as Scott of the Antarctic.
8. Do you think that space exploration has made the world a safer place? Russians and Americans now live and work together in space, on the International Space Station (ISS), destroying the mistrust of the cold war.