

# Astronomy and space outreach new requirements for a new generation

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**Abstract.** Shortcomings in current science outreach contribute to a disconnection between science and society; prompting new requirements in thinking about what science outreach is and how it is planned and implemented. It is proposed here that central to successful outreach should be focus on identifying and communicating value in, and the relevance of, science; rather than necessarily attempting to inspire interest in, or understanding of science. This, coupled to world coordinated identification of key science outreach directives, messages and plans point to more effective science outreach relevant to the global community.

**Keywords.** space science, outreach

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## 1. Introduction

The scientific community has traditionally engaged astronomy and space outreach in particular through an assumption of an underlying awe-inspiring and special nature to those endeavours. In reality most people do not consider astronomy and space exploration to be more important than other human endeavours or deserving of special attention and resources. Such a mismatch contributes to ad-hoc success with science outreach. Furthermore, significant challenges within science –many of them new and emerging– contribute to the situation.

Hence it can be argued that the rôle and function of science outreach requires new thinking –with an underlying assumption perhaps being that astronomy and space science are not necessarily more special (or seen as more special) than other human endeavours; but are nevertheless of quantifiable value and relevance. Such an assumption demands new thinking about value and relevance in science; and more sophisticated, planning and implementation of science outreach programmes on a global scale.

## 2. Challenges within science

Many issues within and surrounding science contribute to poor outreach and ineffective engagement by society:

(a) The ever-changing face of science. Improving and changing theories, incomplete theories and hotly debated areas in ‘big science’ such as cosmology, life in the universe, origins, genetics and so forth all require better context building and explanation to the public.

(b) Contentions within science. The science versus religion debate, dubious applications of science for military and genetics purposes among other contentions all require better debate, global consensus and communication.

(c) Poor understanding of nature. There is poor understanding of the nature of our planet and its cosmic context, both in the developed and the developing world. As one

example, Harvard-Smithsonian studies† reveal that in the US, more than 50% of students sitting high school courses in space science retain a flawed understanding of the cosmos. These studies also reveal a mismatch between what teachers think their students understand and what those students actually understand.

(d) Poor understanding of what science is. Many scientists do not sufficiently understand what science is or what constitutes good science. This affects judgement, argument and civil guidance in key and contentious areas. Examples include the evolution of life, global warming and space exploration. Likewise, too many in the public domain –most importantly those in positions of power such as legislators and media personnel– do not understand what science is, its key priorities, the value of science, current consensus on contentions and so on; leading to potentially flawed or poor legislation, education planning and media coverage.

(e) Insufficient explanation of change in science. Many aspects of science change significantly on yearly and decade-long intervals, but with the non-expert often unaware of such change. As one example, most are vague even on the basic nature of the night sky; yet regularly new discoveries from the likes of the Hubble Space Telescope (HST) are presented over mass media without context, for example the pre-Hubble versus post-Hubble perspective or the nature and relevance of the discovery.

(f) Poor understanding of the value and relevance of science. Value and relevance in science are poorly understood, both by scientists and by the public at large, with space exploration faring poorly in this regard.

(g) Global dependence on science. Global infrastructural and environmental requirements are increasingly dependent on science and require improved outreach.

(h) Commoditisation of science. Science is increasingly seen as niche and not central to society. The situation is exasperated by labels such as ‘popular science’ and ‘scepticism’ which brand and package science for a commodity/consumer society. Although a recent phenomenon, this state of affairs is already accepted as the norm even by the science community.

(i) Science for kids only. Virtually all science outreach centres are kids based. Such centres see their survival rooted in child education and outreach only. Rather, their survival should arguably be guaranteed from the outset so that they can pursue programs relevant to the entire population.

(j) Global cultural challenges in science, its outcomes and perceptions. The onset of the ‘Global Village’ in tandem with increased sociological reliance on science bring about many contentions and dilemmas in areas such as genetics, the environment, international law of space exploration and so on. All of these represent the front line in science outreach and should arguably be high priority to the organisations such as the IAU and UNESCO.

### 3. Challenges in science outreach

How science outreach is currently pursued is also problematic.

#### 3.1. Engagement with the public

- The public are unaware of their levels of scientific literacy or of the necessity for scientific literacy; with little leadership from the scientific community in this regard.
- Many feel disconnected from science and its findings.
- Scientists too often unwittingly undermining science when particular aspects are

† NASA/Harvard/Smithsonian Institution, 2005, *Beyond the Solar System: Expanding the Universe in the Classroom* <http://www.cfa.harvard.edu/seuforum/btss>.

found to be flawed or incomplete. Here, the scientist tries to appeal to ‘the common man’ by revealing that science is not perfect, but in the process undermines well founded value in science as a whole by not also providing insight into the process of science and its self improving mechanism or by explaining the difference between good and bad theories, old and new theories and updated theories (i.e., that science actually works this way).

### 3.2. *The scientific community and science outreach*

- There is insufficient dialogue, debate, action or coordination regarding science outreach on a global scale and by organisations such as UNESCO and the IAU.
- Science outreach is too often seen as a late requirement, whereas it can be argued that it should be integral to all science projects and missions.
- Many in science do not sufficiently value outreach, or those pursuing it.
- Many scientists do not understand the value or sociological relevance of their endeavour well enough for outreach purposes. Examples here include evaluating Mars exploration, the value of a discovery of microbial life as distinct from intelligent life elsewhere in the cosmos, the implications to discovering such life and so on; despite most of these issues having being robustly resolved in the 1960s<sup>†</sup>.
- Fundamental problems in how science outreach is perceived and implemented, include:
  - Lack of adult engagement.
  - The near ubiquity of the presumption that enthusiasm is needed to inspire interest in science; as distinct from valuing earnest dissemination of relevance in science to the dispassionate majority.
  - Science outreach increasingly becoming science entertainment.
  - Dumbing down of science centres (where for example it is virtually impossible to find a planetarium which provides a star show).
  - Lack of engagement of true and earnest cultural depth in science; the historic impact of astronomy, its importance in shaping the modern world, the universal ‘latent’ philosophical importance of space and the findings of astronomy and space exploration, the ongoing devastating loss of dark skies ...
- Too often, key relevancies in science are not explained well enough to the media by scientists in high profile projects. Repeated examples arise here with space exploration. It is rare for a space scientist to be able to sufficiently answer questions posed by media on why, for example money should be spent on space exploration in general or on the value of space exploration.
- Media based space exploration outreach is too often ad-hoc, rushed and sprung upon the general public, who have little time to absorb the full impact of the endeavour.
- Scientists not identifying for themselves the difference between the technical details and the outreach necessities, akin to a painter explaining brush strokes rather than the meaning in a painting.
- Scientists not recognising that science is ‘not about us’; it’s about society and nature.
- The scientific community not recognising that it is not the fault of the non-expert that they do not understand science or cannot gauge its value; and that it is the rôle of the scientific community to disseminate findings with sufficient clarity and relevance.

<sup>†</sup> NASA SP-4212 *On Mars: Exploration of the Red Planet 1958-1978*, available at the website <http://history.nasa.gov/SP-4212/on-mars.html>

### 3.3. Science outreach and the media

Presentation of science by the media also requires addressing. Too often the media, not the scientific community set the extent of coverage, the agenda; as well as derived perspectives, insights and conclusions:

(a) A current trend with media involves presenting 50-50 weightings across areas of science whether contentious or not, leading to increased risk of misrepresentation.

(b) Increased superficiality and requirement for entertainment value leads to poor science outreach. As one example, the BBC's 2001 'Space' documentary series used an actor as the key presenter in an attempt to engender a sense of drama, but which arguably lead to greater superficiality in the science and its value and relevance.

(c) Reality and fashion-based TV science programs lead to superficial science.

(d) The scientific community is not critically involved in driving science outreach, whereas it is responsible for publishing and managing science journals. Arguably this reveals a lack of a priority for engaging science outreach.

## 4. Science outreach – a new approach

The above issues suggest that new approaches are required in how science outreach is defined, planned and implemented. Furthermore, it can be argued that many of the shortcomings in the success of science outreach are not a result of lack of resource but rather relate to ethos, awareness, strategy and organisation on the part of the global scientific community.

It is therefore proposed that to improve science outreach, the following should occur on a global-organisation level:

(a) Define clearly what science outreach is and what its purposes and rôles are.

(b) Strive for consensus in every possible area of scientific endeavour.

(c) Identify key values and relevancies in science and nature.

(d) Declare science outreach as part of 'the process of science'.

(e) Identify and specify the rôle of scientists in outreach.

Only after these have been engaged can a global effort be undertaken to organise and derive core science outreach messages, directives and activities relevant to a new generation and for the twenty first century:

(a) Organise on a global-scale and identify the role of major science organisations.

(b) Produce world class directives, direction and guidance in key areas of science, their value and relevance, and for various cohorts (adults, children, media, legislators ...).

(c) Derive key and core outreach messages in all major branches of science.

(d) Derive outreach program guidelines and/or programs which include feedback for improvement from local implementation to global strategy.

(e) Produce definitive content usable by, and which feeds into, science organisations, individual science missions and groups, media briefs, education, international and national policy and legislation.

## 5. A proposed definition of science outreach

A proposed definition of what science outreach is is proposed here –not as being an endeavour to only make science interesting or even understandable– but rather as “*an endeavour to reveal the value of nature and science across a range of human, worldly and natural scenarios; in order to enable enlightenment, informed decisions and actions by all cohorts across humanity, for the betterment of society and the sustainability of all natural environments we engage*”.

There need be no conflict with traditional outreach –making science interesting can also be a priority– but it is suggested that making it valuable and relevant to all society is of greater and deeper importance.

## 6. Consensus and value in science – a global challenge in ‘scientific perspective’

To implement effective science outreach, the global science community must also strive to identify true value in nature and science. While this cannot be completely achieved, many core values and relevancies have been determined over the past century and especially; with many key sociological relevancies in space exploration robustly identified as far back as the 1960s. Yet, too frequently astronomers and space scientists are unclear on the key values and relevancies, cannot articulate them clearly enough or incorporate them into science outreach programs.

Significant outstanding scientific issues also persist among various cultures which need to be acknowledged internationally and then examined and addressed towards resolution. Examples include evolution, nuclear technology, ethical and moral issues across the life sciences, planetary protection with regards to Lunar and Mars exploration, among many others. There can be no capable global science outreach on these increasingly pressing issues until they have been addressed as well as is possible on a global scale by the scientific community.

While it is not the role of this paper to offer absolutes in these areas, any efforts toward global consensus on value in science might consider for example an equivalent to the *Hippocratic Oath* as a guide in the education of new generations of scientists. Similarly, it could also be argued that across most cultures the pursuit of good science and science outreach should support valued decisions critical to the survival and well being of the community and our world, the enlightenment of all in society, to fulfil our historical and future society obligations, and to help science itself to unfold in an optimum way.

In striving toward more effective science outreach, the specific role and responsibility of scientists and science organisations in outreach needs particular attention. Firstly scientists should know the top priorities, major social relevancies, major debates and areas of general scientific consensus. Scientists should also be capable of engaging science outreach at least to the extent of being aware, of sorting and of communicating the relevant issues. Enthusiasm need have nothing to do with it.

## 7. Strategy and implementation on a global scale

Effective global outreach will also requires effective global organisation: From the IAU, UNESCO, NASA, ESA, ESO to the major universities among others, all should work strategically together to set out core priorities, values and relevancies, consensus (where possible), directives and so on in the major branches of science. Only after this has been successfully achieved can outreach programs relevant to a global community be derived. For example, it should not be the rôle for a single space mission to present outreach messages required to convince the public (or the media) of the value of space exploration in general. Rather, that singular message should be derived at the highest level and disseminated to all, so that when media coverage of an individual mission occurs, all concerned are already clear on the big picture, allowing for individual outreach specialists to be able to concentrate on the mission at hand.

Hence, in the case of space exploration for example, world organisations should work strategically together to derive and explain general rationales, motivations values and relevancies; which enables all concerned to subsequently identify context for individual programs and missions. Subsequently, individual astronomy and space organisations, in cooperation with one another, can organise:

- For any given outreach venture, determine strategies and deliverables particular to the various cohorts – students, adults, legislators, media, religions, science enthusiasts, science sceptics ...
- For each mission or project, derive an outreach mission plan and budget.
- Develop effective and relevant outreach packs for all scientists involved with a given mission or project.
- Provide feedback mechanisms from individual projects to global organisations; with relevant new outreach requirements added to the broader context where relevant.
- Parent organisation to audit outreach endeavours and survey the media and the public and sustain relevance and focus in outreach policies and statements. These need to be sophisticated audits and surveys far and beyond current norms – identifying deep rooted and far reaching issues associated with public perception of nature, the environment, science and science outreach and so on.

## **8. Conclusion**

Science outreach must play an increasingly important role, given the many challenges facing science, nature and society. Current approaches to science outreach are inadequate and result in a disconnection between society and science. Much of the problem stems from poor understanding of what science outreach is and how it is implemented on a global scale. In particular, the underlying assumption that science outreach is about enthusing people in science is arguably flawed or limited. Rather, a definition of science outreach based on disseminating value and relevance in science arguably stands a better chance of being effective. If coordinated from a small number of global organisations, core science messages, global strategies and their derived outreach programs could set about removing many false perceptions about science, enable better decision making on issues involving science and technology, provide for better enlightenment across society and enable better prioritising of science itself.