

## **“Educational cum Training Programme on Solar Eclipse for Students, Teacher & Parents”, New Delhi**

Supported by:  
NRDMS Division  
Department of Science and Technology, Govt. of India

Date: 29<sup>th</sup> March 2006  
Venue: Tagore International School, Vasant Vihar, New Delhi

### **‡ Theme:**

Community partnership network of teaching and student communities, and parents about causes and impacts on our lives & atmosphere of solar eclipse and what safety measures to be adopted during the solar eclipse watching period.

### **Introduction**

Solar eclipse is probably the most spectacular astronomical event that most people will experience in their lives. There is a great deal of interest in watching eclipses, and in the days and weeks before an eclipse occurs, there are often news stories and announcements in the media, providing information on what will happen, and how to watch the eclipse safely.

As the Moon orbits around the Earth, the Moon crosses the direction from the Earth to the Sun once every 29 days 12 hours and 44 minutes. We call this moment New Moon. The Moon actually becomes visible again a day or two after New Moon, as a thin crescent in the evening sky. The plane of the orbit of the Moon around the Earth is tilted at 5 degrees to the plane of the Earth's orbit around the Sun. Hence at the time of New Moon, the Moon usually passes above or below the Sun, as seen from Earth, and there is no eclipse. There are two places in the Moon's orbit where it can pass exactly between the Sun and the

Earth. These are called the nodes of the orbit. If the Moon is at or near either of these nodes at New Moon, an eclipse of the Sun occurs. There is an interval of 31 days that occurs every 5.8 months, when the alignment to give us eclipses can happen.

As the sizes of the Moon and Sun as seen from the Earth are almost the same, the Moon can completely block the light of the Sun over a small part of the Earth. In the same way, you can block out a distant building by holding your hand in front of it, even though the building is much bigger than your hand. The Moon passing in front of the Sun produces a shadow that moves from west to east over the Earth. Where the sunlight is completely blocked, in the "umbra", a total eclipse is seen. Where the sunlight is only partly blocked by the Moon, in the "penumbra", a partial eclipse is seen.

### **Methodology**

The methodology was interactive participatory based on lecture cum practical visual demonstration, literature, and posters & banners on solar eclipse, i.e. solar eclipse falling on 29<sup>th</sup> March 2006.

### **Objective**

- To explain about what causes eclipses and why? How often do eclipses happen and when is the next eclipse of the Sun?
- To educate on what will happen and the effects of solar eclipse.
- To educate on what to do and how to watch the eclipse safely
- To provide practical demonstration during the total solar eclipse.

### **Targeted Beneficiaries**

The target beneficiaries of the proposed programme are teachers, students and parents from Schools of Delhi.

## State of Knowledge

Solar radiation reaching the surface of the earth ranges from ultraviolet (UV) radiation at wavelengths longer than 290 nm to radio waves in the metro range. It is widely accepted that environmental exposure to high levels of solar UV radiation contributes to the accelerated ageing of the outer layers of the eye and skin, and the development of cataracts. However, observing the sun with inadequate or no eye protection results in "eclipse blindness" or retinal burns because the eye transmits most of the optical radiation between 380 nm and 1400 nm to the light-sensitive retina.

Exposure of the retina to high irradiance levels of visible light triggers a series of complex chemical reactions within the light-sensitive rod and cone cells. The resulting photoproducts damage the cells, impairing their ability to respond to light, and in extreme cases can destroy them. Depending on the severity of the damage, an affected observer experiences either a temporary or permanent loss of visual function. This photochemical retinal injury mainly occurs when the retina is exposed to blue and green light. Longer wavelengths of visible light and near-IR radiation are absorbed by the dark pigment epithelium below the retina, and converted into heat which can literally cook the exposed tissue. This thermal damage also occurs during extended exposure to blue and green light. Photocoagulation destroys the rods and cones, leaving a permanently blind area in the retina.

Each wavelength of optical radiation has an associated threshold retinal exposure level that must be exceeded in order for retinal damage to be observed - shorter wavelengths are more effective in that less energy is needed. The danger to vision of inadequately protected viewing of the sun is significant because light-induced retinal injuries occur without any feeling of pain (there are no pain receptors in the retina), and the visual effects do not occur for at least several hours after the damage is done.

Because the threshold exposure levels for photic damage to the retina at each wavelength of the optical spectrum are well known, it is fairly simple to calculate the maximum permissible filter transmittance that will provide adequate retinal protection from sunlight. The ratio between the threshold retinal irradiance for light damage to the solar spectral irradiance at each wavelength provides a starting point for this. The worst case scenario assumes that the sun is at the zenith in a clear sky (air mass of 1). The maximum permissible transmittance level of the filter at a given wavelength can be arbitrarily set at between one per cent and 0.1% of this ratio to provide a "safety" factor. When this is done for the waveband between 380 and 1400 nm, we find that a filter with a luminous transmittance of 0.0032% in the visible spectrum corresponding to a shade number of 12 provides "adequate" retinal protection during solar viewing. However, this does not take into account visual comfort; for comfortable viewing of the sun, a filter with a luminous transmittance of 0.0003% (shade number 14) is often preferable.

**Solar eclipse from 2001 through 2008:**

<b>SOLAR ECLIPSES: 2001 – 2008</b>				
<b>Date</b>	<b>Eclipse Type</b>	<b>Eclipse Magnitude</b>	<b>Central Duration</b>	<b>Geographic Region of Eclipse Visibility</b>
2001 Jun 21	Total	1.050	04m57s	e s. America, Africa [Total: s Atlantic, s Africa, Madagascar]
2001 Dec 14	Annular	0.968	03m53s	N. & C. America, nw S. America [Annular: c Pacific, Costa Rica]
2002 Jun 10	Annular	0.996	00m23s	e Asia, Australia, w N. America [Annular: n Pacific, w Mexico]
2002 Dec 04	Total	1.024	02m04s	s Africa, Antarctica, Indonesia, Australia [Total: s Africa, s Indian, s Australia]

Educational cum Training Programme on Solar Eclipse for Students, Teacher & Parents

2003 May 31	Annular	0.938	03m37s	Europe, Asia, nw N. America [Annular: Iceland, Greenland]
2003 Nov 23	Total	1.038	01m57s	Australia, N. Z., Antarctica, s S. America [Total: Antarctica]
2004 Apr 19	Partial	0.736	-	Antarctica, s Africa
2004 Oct 14	Partial	0.927	-	ne Asia, Hawaii, Alaska
2005 Apr 08	Hybrid	1.007	00m42s	N. Zealand, N. & S. America [Hybrid: s Pacific, Panama, Colombia, Venezuela]
2005 Oct 03	Annular	0.958	04m32s	Europe, Africa, s Asia [Annular: Portugal, Spain, Libia, Sudan, Kenya]
2006 Mar 29	Total	1.052	04m07s	Africa, Europe, w Asia [Total: c Africa, Turkey, Russia]
2006 Sep 22	Annular	0.935	07m09s	S. America, w Africa, Antarctica [Annular: Guyana, Suriname, F. Guiana, s Atlantic]
2007 Mar 19	Partial	0.874	-	Asia, Alaska
2007 Sep 11	Partial	0.749	-	S. America, Antarctica
2008 Feb 07	Annular	0.965	02m12s	Antarctica, e Australia, N. Zealand [Annular: Antarctica]
2008 Aug 01	Total	1.039	02m27s	ne N. America, Europe, Asia [Total: n Canada, Greenland, Siberia, Mongolia, China]

Geographic abbreviations: n = north, s = south, e = east, w = west, c = central